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AUTHOR	Norman, John, Ed.; And Others
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ABSTRACT

This collection of environmental education mini-units presents class activities of a multi-disciplinary nature appropriate for a variety of secondary-level grades. Each lesson of a mini-unit includes specified objectives, list of materials, and procedures. The procedure segment sometimes provides several activities, including instructions, from which a student may choose. Concluding the lesson are references or discussion questions. (BE)

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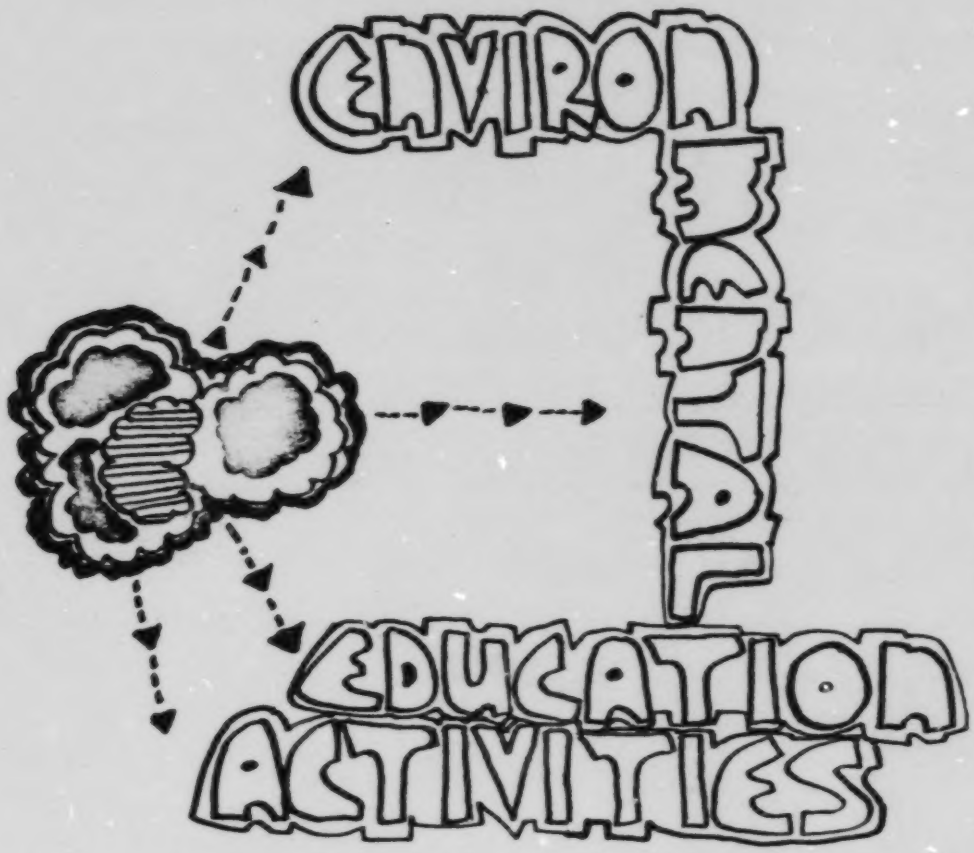

7TH – 12TH

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PROJECT R.E.N.E.W.
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1978

SE 029 287

FOREWARD

This booklet is representative of the fine efforts of those who were recipients of a grant from the U.S. Department of Education - Environmental Education Personnel Training, #G007701226 entitled "Project RENEW." The emphasis of this project was on the training of secondary teachers in the Metropolitan Detroit area. The workshops were held at Wayne State University under the direction of Dr. John Norman. The primary topics considered here were land use, air quality, water quality, and energy use.

It has been our goal to present units and activities that were developed as part of our training effort. They represent a variety of grade levels and are multidisciplinary in nature. Most of these teaching activities lend themselves to a process approach to environmental education. We hope that you will find these units and activities to be useful.

EDITORIAL TEAM

Dr. John Norman, Editor

Ms. Barbara Dempster

Ms. Mary Gendernalik

Ms. Mary Jean LeBlanc

Ms. Julie McDonnell

Mr. Jim Urban

Ms. Shirley Wahlstrom

Project RENEW Participants

Name	School	School District
Patricia Burnell	St. Thecla	Archdiocese of Detroit
John Campbell	Plymouth-Salem High	Plymouth-Canton
Robert DeLashmit	Truman High School	Taylor School District
Barbara Dempster	Redford Union High	Redford Union Township
Vincent DeSanto	Garden City High	Garden City Public
Arthur Durow	Plymouth-Salem High	Plymouth-Canton
Linda Gagnon	Grant Junior High	East Detroit Public
Cheryl Greene	St. Clair of Montefalco	Archdiocese of Detroit
Bernice James	Lincoln Elementary	Inkster Public
Vitalija Keblys	Redford Union High	Redford Union Township
Dean Lande	Bishop Foley High	Archdiocese of Detroit
Patricia Lease	Plymouth-Salem High	Plymouth-Canton
Mary Jean LeBlanc	St. Mary Magdalen	Archdiocese of Detroit
Julie McDonnell	Immaculate Heart of Mary	Archdiocese of Detroit
Terri Merritt	Fellreth Junior High	Inkster Public
Joseph Mikula	Rochester Adams High	Rochester Community
Richard Nader	East Detroit High	East Detroit
James Newman	Ottawa Junior High	St. Clair Shores
Daniel Oden	Oakwood Junior High	East Detroit
Xavier Pankovits	DeLaSalle Collegiate	Archdiocese of Detroit
Aldona Petrauskas	Gabriel Richard High	Archdiocese of Detroit
Barbara Porter	Stevenson High	Livonia
James Potter	Cherry Hill	Cherry Hill School District
Creola Powell	Fellreth Junior High	Inkster Public
Margaret Raglin	Fellreth Junior High	Inkster Public
Arlene Rama	Bishop Foley High	Archdiocese of Detroit
Elizabeth Rashid	Our Lady of Loretto	Archdiocese of Detroit
James Rustowicz	Emerson Junior High	Livonia Public
Larry Schulz	Ottawa Junior High	St. Clair Shores
Monica Schultz	Garden City High	Garden City Public
Edwin Thomas	Truman Senior High	Taylor Public
Fred Thomas	Fellreth Junior High	Inkster Public
Helen Trahey	St. Mary Magdalen	Archdiocese of Detroit
Thomas Tristani	Dominican High	Archdiocese of Detroit
Jim Urban	Northville High	Northville Public
Shirley Wahlstrom	Emerson Junior High	Livonia Public

WATER

Grade Level: 7-12

Title: Water Quality - A Mini-Unit

Objective(s):

1. The student will become acquainted with water quality and its' importance to mankind.

2. The student will define and list new terms in order to recognize them while researching.

3. Each student will write letters seeking information on water quality.

4. Each student will become familiar with sewage treatment, its levels, expense and importance.

5. Students will develop an understanding and appreciation for fresh water as a natural resource.

Materials:

classroom materials only

Procedures: (Individual Approach)

Students can choose from the following activities:

ACTIVITY #1

Below is a list of terms associated with water. On a separate sheet of paper define these in your own words. Try to guess at the terms meaning regardless of your familiarity to them.

-primary treatment
-secondary treatment
-tertiary treatment
-conservation
-oxygen
-hydrogen
-nitrogen
-runoff
-fertilizers
-visibility
-irrigation
-precipitation
-evaporation
-light penetration
-bacteria
-carbon dioxide

Compare your definitions with a fellow student. Then, look up the correct definition. Design a crossword puzzle using ten new terms.

ACTIVITY #2

Review five articles from recent editions of the newspaper or news magazines on a specific water pollution problem, i.e., Lake Erie, the Rouge River, phosphates in the Great Lakes. Use the librarian and the Reader's Guide to help you locate current and informative articles.

Write a summary of what you have discovered about your particular topic. Do you agree or disagree with what is being done to solve the controversy? Write a short opinion paper describing what advise you have to offer. You may even want to submit your opinion to a local newspaper, television, radio station or government official.

ACTIVITY #3

Find out about three large metropolitan cities and exactly what they do to recycle sewage. What type of sewage treatment is available, are more plants in the making, do they have a tertiary treatment station, is there enough sewage treatment available to meet the demands of new homes and buildings?

Make a simple chart illustrating the comparison between the three cities.

ACTIVITY #4

Choose one of the activities below. This may be done with a partner or small group. Ask your teacher if you can duplicate your findings and share it with the class.

-Trace a glass of water that has been poured down a drain. Draw a detailed map or list each place it goes after leaving the glass.

-A rainstorm just stopped outside. It rained enough to leave large puddles and muddy ground. Trace the raindrops from the sky to the ground and back to your sink.

ACTIVITY #5

There are many different types of water pollution. Several are listed here:

1. sewage
2. infectious agents
3. nutrients
4. synthetic organic chemicals
5. inorganic chemicals
6. sediments
7. radioactive materials
8. heat

On a sheet of paper make a chart and list the ways in which each of these categories damages the water we depend on. Below are several book titles that may be valuable to you.

ACTIVITY #6

Twenty percent of all the fresh water in the world lies in the Great Lakes. Ten percent of all the fresh water lies in Lake Superior alone. On a large map locate other large bodies of fresh water as well as salt water.

On a large sheet of cardboard carefully draw a topigraphical map of the world. (This may require more than one sheet of cardboard.) Sketch all the land masses in brown, the fresh water in blue and salt water in green. This is just an outline or sketch so there is no need to color or fill in the land masses. This map will give a view of exact water resources.

ACTIVITY #7

It has come to the attention of the government in recent years that we are a very rich country, inasmuch as natural resources are concerned. There has also been a scary and rather conservative drive in the past decade.

Many environmental groups and government officials have been working to ban industrial polluters. But, as we know, there are many sides to the industrial pollution controversy. If certain measures and new standards are to be implemented, it will cost individual companies and government many financial difficulties. On the other hand, if pollution does not cease, our supply of water and natural resources will.

With all of our advanced technology it seems there should be a way to go about pleasing both sides in this issue. Find out what the regulations are on phosphates. Summarize briefly then add your opinion. So many people, including legislatives and officials can see both sides. If everyone continues to see both sides and nothing definite happens, the pollution and controversy will remain.

Bibliography:

Natural Resource Conservation. Owen, Oliver S., Macmillan Co., New York.

Environment and Man. Wagner, Richard H., W.W. Norton & Company, 1974.

Water Pollution. McCaull, J. and Crossland, J., Harcourt Brace Jovanovich, 1974.

Everyman's Guide to Ecologival Living. Caillet, Macmillan Co., 1971.

Submitted by: Julie A. McDonnell

Grade Level: 7-12

Title: Investigating Flood Plains and the Effects of Phosphates and Nitrates on the River

Objective(s):

1. To compare soil samples in your area before and after the spring lawn fertilizers are added, and to see what effect this has on the rivers or streams.

2. To investigate the flood plains in your area.

   a. Past flooding areas
   b. Areas that are likely to flood in the future
   c. To try to plan ways of preventing the flooding

Materials:

one tin can opened on both ends
soil sampling kits
water testing kits
maps of area
map showing flood plains
map of the rivers which will be constructed by the class

Procedures:

1. As soon as the frost is out on the ground, cut the ends out of a soup can, place the soup can on your lawn in an upright position. Step on the can, forcing it into the ground. Remove the can, with dirt sample inside and bring it into the classroom.

2. Test the soil for nitrogen and phosphorus using the soil testing kits.

3. Go to some area near where you live along the river. Get a small jar of water and bring it to class. Test it for nitrates and phosphates using the kits provided.

4. Save the above data until you and/or your neighbors begin to fertilize your lawns...then repeat both operations.

5. Put both sets of information on the "Master Sheet." Give the location of the soil samples and water samples, and mark the locations on the map.

6. Study the flood plains maps of the river. Find the spot nearest your house, and with a friend, ask the residents along the river about their experiences with flooding in the past. Try to get the years the flooding occured, the damage done, and the height of the river, both normal and at flood times.

7. Check the slope of the riverbank. Make any kind of guess you can about how fast the river is flowing by throwing a stick into the river and timing its flow for one minute.

8. Make any other observations you can about the river, and bring this information back to the classroom.

Observations and results:

1. How do the soil samples compare before and after fertilizing?

2. How does the amount of nitrates and phosphates in the rivers compare before and after the fertilizing of lawns?

3. What effect will the nitrates and phosphates have on the wildlife in the area?

4. Where does the river come from, and where does it eventually flow?

5. Does this "pollution" from phosphates and nitrates have any effect on the water supply? From where do we get our watter?

6. What other kinds of pollutants are in the river? (old tires, picnic tables, logs, pipes, cans, bottles, paper, dead animals, etc.) Who puts this litter here?

7. Who is responsible for keeping the rivers clean?

8. Would flooding be less likely in a fast or slow moving stream? Why?

9. How could we speed up or slow down the rivers?

10. What reaction did you get from the residents along the river about the flooding? Would they be willing to help in a project to clean up the rivers and check the flooding?

11. List some of the organizations that have had "Clean the River" drives. Have you participated in any of these drives?

12. Why aren't there any fish in the river?

Conclusion:

After studying all the available data we have gathered, can you draw any conclusions about what must be done to "Save the River".

Submitted by: Barbara Dempster

Grade Level: 6-12

Title: A Measurement of Water Content in Snow

Objective(s):

1. To discover the relationship between water and snow.
2. To show that different types of snow contain different amounts of water.
3. To bring to light the effect of winter snow cover on spring thaws, drainage and erosion problems.

Materials:

collecting pans
meter sticks
large spoons
scale or balance (in grams)
large calibrated beaker (1,000 ml)
Bunsen burners or oven (some heat source)

Procedures:

1. Students (two per team) are to measure one (1) square decimeter (10 cm x 10 cm) (this can be expanded to 1 m x 1 m under light snow conditions).
2. Record overall snow depth.
3. Collect all the snow in the one square decimeter in the collecting pan.
4. Pack snow into the beaker.
5. Return to class and place beaker over bunsen burner and heat to melt snow.
6. Pour water into a dry, pre-weighed beaker (NOTE: if beakers are used to collect the snow, mass them before you take them out).
7. Record volume of water. Place on balance and record mass of beaker and water, calculate mass of water.
8. From field notes, calculate the volume of snow collected (length x width x depth).
9. Set up rations: volume of snow; volume of water and volume of snow; mass of water (1 ml of water has a mass of 1 gram, so that these ratios should be equal).
10. Calculate the area of a large surface (i.e., school lawn) and calculate the amount of snow, water volume and mass (assume no drifting). You'll get impressive numbers and oohs and ahhs.

11. You can also construct a class average ratio (especially if snow depth is variable) by using all the individual results and averaging them.

Questions:

1. Compare results against those for other snow conditions (powder, slush).

2. Discuss the effects of rapid spring thaws and where all the water goes.

Submitted by: Patti Lease, Art Durow and John Campbell

Grade Level: 7-12

Title: Water Meters

Objective(s):

To learn how to read the water meter in your home.

Materials:

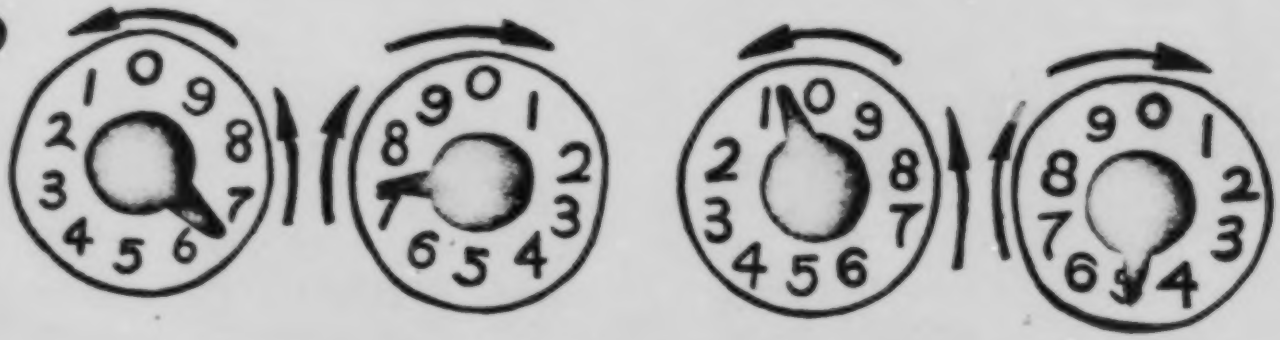
water meter in your home

Procedures:

It is easy to read the water meter. It usually has four dials. To read it start with the LEFT dial. Write down the number that the indicator passed last. Do the same for the other three dials. The number of cubic feet of water is obtained when the numbers are written together. For example, the dials may read 6705. If next week the reading is 6805, then 100 cubic feet of water has been used. Fill in the chart on your data sheet each day.

Make a graph showing how much water is used daily for one week.

To find the average number of cubic feet of water used each day divide 7 into your total number of cubic feet.



This meters reads 6705.

Questions:

1. How many cubic feet ($ft.^3$) of water would you estimate are used in your home daily, weekly, or yearly?

2. How does one go about figuring out a months water bill?

Adapted from:

The Environmental Science Probing the Natural World/3. Silver Burdett - General Learning Corporation.

Submitted by: Shirley Walhstrom and Jim Rustowicz

Grade Level: 7-12

Title: Water Study

Objective(s):

1. To determine the oxygen content of water by the type of organisms living in it.

2. To determine the predator - prey relationship of organisms in a pond.

Materials:

collecting jars
buckets
white porcelain trays
large kitchen strainers - attached to poles
boots or waders
Pond Life (Goldenbook)
thermometer

Procedures:

Walk or drive to pond. Observe and record the general characteristics of the pond. What do you see? What do you hear? Is there any odors? What is the temperature of the air? What is the temperature on the ground? What is the temperature near the surface of the water? What is the temperature near the bottom of the pond? (Don't go beyond one foot depth - this study is done near the shore.)

Observations:

Do you see any organisms near the surface? Scoop up water near the surface and pour into porcelain trays. Observe. Pour all organisms into buckets to be taken back to classroom. Now look below the surface of the water. Do you see any organisms? Scoop below the surface with the collecting jars, or kitchen strainer and pour into porcelain pan for observation. Pour all organisms into buckets to be taken back to the classroom. Now try to see the bottom of the pond. What organisms do you see that you didn't see before? Using the kitchen strainer or collecting jars, scoop up some of the bottom mud and water and pour it into the porcelain pan for observation. Collect any organisms and pour into buckets for observation in classroom.

Results:

Back in the classroom, pour the organisms into several large white porcelain pans. Using the Goldenbook of Pond Life, identify the organisms and take a count of the numbers of each type. Check daily for one week (a few minutes a day) and see whats' left by the end of the week. This gives you the predator - prey relationship. The Goldenbook of Pond Life will also tell which of these organisms are high oxygen consumers. You can determine the general oxygen content of the pond by the types of organisms you find in it. (Example: caddis fly larva only occupy ponds with a high oxygen content - so if

you find caddis fly larva, it is possible for high oxygen consuming fish, like trout, to be found also.)

Conclusion:

From the organisms you have found in the pond, would you say this is a high oxygen-content pond? Does this pond support many types of plant and animal life or just a few? What is the predator - prey relationship in the pond? What happens to these organisms in winter? and in summer?

Submitted by: Barbara Dempster

Grade Level: 7-12

Title: Water and Energy

Objective(s):

1. In the study of water and energy it is important that students understand our need for pure water and the cost involved in obtaining it.

2. Develop group discussion and decision making, and library research skills.

3. Be able to understand the interdependence of pure water and energy.

4. Perform simple tests, i.e., determine the quantities (relative) of nitrate ionsm, PO_4^{-3}, O_2 and pH of water sample.

5. Understand the interrelation of the source of water vs. pollution and/or contamination. i.e., spring water vs. river in the park

6. Understand nature's vs. man's process of purification.

7. Identify major sources of pollution and the costs involved in purification, conservation, and usage.

8. Be able to relate to the economical, social and political implications in the event of a "break" in the water supply.

Procedures:

Part I:

Show the film: "A Silent Toast to Water"
(this film gives the needed background to the sources and purification cost of drinking water. Excellent film for this purpose.)

Discussion follows: How are energy and pure drinking water related?

Ask the following:

a. Is the water that you are drinking safe for human consumption?

b. How will the quality of water change (if at all) if the cost of energy increases?

c. How would your mode of living be changed if the municipal supply of water would be cut off?

d. What would happen if bacterial or chemical contamination would take place in the main water supply terminal (in case of an enemy attack)?

Assignment:

Keep one week's log on water consumption by the family. At the end of the week compare results with other students. Calculate the number of gallons consumed (on the average) by the residents of Redford Township.

Part II: Water and Energy: Purification

By means of lecture and films or by taking a field trip to the waste treatment plant, provide the student with enough background for better understanding of the steps and processes involved in water purification and the cost of such undertaking.

In order for the water to be fit for human consumption, money must be invested in plant construction and operation.

a. Where will the money come from and who should be in charge of the operation? Private sector or municipal? What are the advantages of private vs. municipal?

b. Since energy is involved in purification, pumping etc., what energy source should be used? (Coal, oil, gas, nuclear) By whome and on what basis should this choice be made?

c. Depending on the class size, maturity, and needs, the following experiments-determinations could be made:

Using water testing kits - available commercially from any biological supply house determine the concentrations of nitrates, phosphates, BOD and pH.

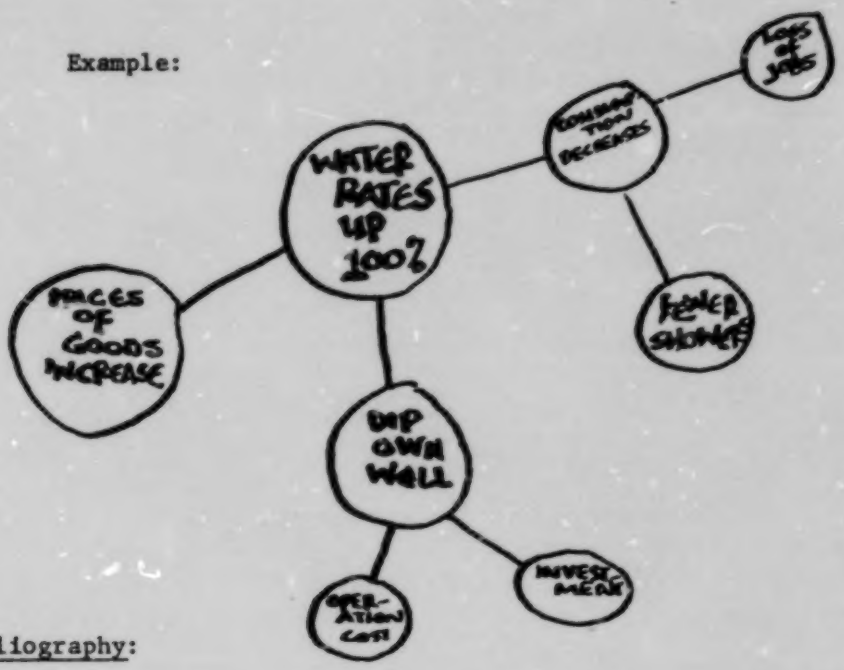
For most dramatic results of tests No. 1 and 2, use water from a fish tank. Tap water and pond water gave negative tests.

Additional Activities:

If sufficient number of kits are available to students, let each student test water in a near-by pond, river or lake. Compare results. Test for nitrates, phosphates, oxygen content and pH.

When the preliminary work is completed, use the spin-off method to generate discussion. On the board draw a circle and inscribe: due to high energy cost water rates are going up 100%. What will be the results of such action?

Example:



Bibliography:

Film: "A Silent Toast to Water"

Detroit Edison handout on energy

Publications by Detroit water and sewage department

Some ideas from the class

Submitted by: Vitalija Keblys

Grade Level:

Title: Quin-Zee Building

Objective(s):

To build a quin-zee and discuss winter survival.

Materials:

shovels
toilet paper
(both optional)

Procedures:

1. To build a quin-zee simply pile snow about five (5) feet high and with a diameter of 7-10 feet.

2. When piling snow, turn all snow over and make sure the layers are mixed well so that it recrystallizes. This is what makes the structure strong and easy to work in.

3. Throw snow on the pile (no big chunks) so that the structure is a hemisphere, not conical.

4. Excavate the following day, making the door as small as possible. Dig down to the leaf litter/lawn.

5. The walls should be six inches thick, so measure as you excavate.

6. Let structure stand for one hour to harden. Four or five people will be able to sit on top of the quin-zee.

7. Spend some time inside the quin-zee. Candles may be place on snow shelfs in the walls. Block the door opening with snow. Record temperature changes with time. (Remember that if the temperature is -60°F outside, the inside of the quin-zee will be 32°F due to the snow, and that's a 90° difference!)

8. The temperature change inside varies with the number of people in the quin-zee and the length of time spent inside. Sleeping inside can be comfortable for several people, as temperatures soar into the high 50's.

9. When the ceiling drips, put toilet paper on the areas. It will freeze and stop dripping.

10. Experiment with different heights in inside cavity and doors.

11. For more information on winter survival and quin-zees, write:

Dr. Richard Reewee
Biology Department
University of Manitoba
Winnipeg, Manitoba, Canada R3T 2N2

Questions:

1. Discuss the possible situations where winter survival knowledge would save lives.

2. Discuss cultures that have used quin-zees and other similar snow structures, and their differences in construction and function.

Submitted by: Patti Lease, Art Durow and John Campbell

Grade Level: 7-12

Title: Environmental Club

Objective(s):

The club will:

1. Nurture the speaking and leadership capabilities of students.
2. Unite students with a common interest.
3. Promote citizenship and patriotism.
4. Develop civic responsibility and a sense of social awareness.
5. Teach students to work with others.
6. The club experience becomes a tool to meet class objectives as well as to encourage growth.
7. The student will become involved in the community.
8. Students will meet business and community leaders.
9. The student develops a sense of belonging.
10. The club members' work will be recognized and saluted.
11. Affiliation with state and national groups.
12. The teacher grows as students grow.

Procedures:

The first step in forming a club at your school is to consult your principal. You should be prepared to define the goals and proposed structure of your group. The support of the student council and the parent-teacher association also is very beneficial.

The best method of stimulating interest among students is to utilize the school newspaper. The public-address system and bulletin board displays also may be very helpful.

At the initial meeting of your club discuss the purpose of the group and talk about what the club would do at the meetings. The teacher must remember that the club should be a student organization and the students and not the instructor should do the planning. The students should write a constitution and by-laws. A name should be selected- not necessarily the environmental club. The second meeting is a good time to select officers.

Club Activities:

1. A field trip to the Water Treatment Center (invite parents).
2. Write letters to the editor concerning environmental problems.

3. Class discussions of environmental problems.
4. A recycling program.
5. Experiments and investigations.
6. Guest speakers.
7. Show films and slides.
8. Make a film.
9. Have a contest.
10. Arrange a bulletin board.
11. Present a play to the school body with an environmental theme.
12. Develop a book shelf in the school library and in science rooms.
13. State a program for your parent-teacher association based on your club activities.
14. Get acquainted with community groups.
15. Arrange social activities such as picnics, dances and parties.
16. Role play environmental situations.
17. Make a membership card.

Bibliography:

Future Business Leaders of America, P.O. Box 17417 Dulles, Washington, D.C. 20041

Vocational Industrial Clubs of America, 105 N. Virginia Avenue, Falls Church, Virginia 22046

Future Homemakers of America, 2010 Mass. Avenue, N.W., Washington, D.C. 20036

Submitted by: Robert L. Delashmit

Grade Level: 9-12

Title: The Environmental and Social Implications of Phosphates in Detergents

Objective(s):

To demonstrate social and biological implications of the addition of phosphate in detergents.

Materials:

list of questions about water, water pollution, waste treatment and water conservation

Procedures:

1. Classroom discussion.

2. Role playing.

Background Information

Phosphate is a very important ingredient in detergents. It removes soil, breaks down oil and grease. It ties up water hardness, and reduced germs on clothes. No effective substitute for phosphates in detergents has yet been found.

However, 18% of all phosphate in domestic sewage and lakes come from detergents. These phosphates are nutrients in the growth of certain algae species. These algae over grow and create the infamous "Algae Boom" whose subsequent death chokes and skills the lake.

Questions:

1. In order of importance, how would you rank the following list?

   a) phosphate producing industry
   b) clean clothes
   c) clean lakes and water
   d) government
   e) jobs in the community

2. How would you rank the above list if you were -

   a) President of the Phosphate Company
   b) fisherman
   c) governmental person living in the town that phosphate industries are located in
   d) citizen living near the lake where phosphate are disposed

3. How does the use of phosphate in detergents affect the list in question #1?

4. Assume one of the following roles for classroom discussion: President of the Phosphate Industry, concerned citizen, union steward for the phosphate industry, a person working in the employment agency, an agent from Department of Natural Resources

Bibliography:

Phosphates in the Environment. The Procter & Gamble Company.

Questionnaire

The following is a questionnaire, assembled to get an idea of your viewpoints regarding water usage and water conservation. Please indicate your answers beside the question, in the left hand margin. Answers are scaled from 1 to 5, with 1 being the lowest, or no, or never, and 5 being the highest, or yes, or always. An answer of 3 would, therefore, indicate a middle-of-the-road position, or 50% of the time, etc.

_____1. Do you know where your household water comes from?

_____2. Do you know where your household water goes after you've used it?

_____3. Consider the following: primary treatment of waste water involves removing most of the solids. Secondary treatment involves removing some of the organics by means of bacterial action. Tertiary treatment involves removing most of the phosphates; this stage is considered highly desirable before our waste water is returned to the natural waterways. Would you demand that the waste waters of the Detroit area be treated by tertiary treatment before it is put back into the waterways?

_____4. Would you disapprove of our waste water treatment methods if you learned that 40% of our waste water receives only primary treatment before being channeled to the Detroit River (the remainder receiving Secondary treatment)?

_____5. Would you drink this water after it received Tertiary treatment?

_____6. Have you ever consumed water which was recycled?

_____7. Are you conscious of leaving the water running from an open faucet when it's not being used?

_____8. Have you tried to cut down on the amount of water you use for bathing?

_____9. If you take a bath, do you let the cold water into the stoppered tub bo begin filling, waiting for the water to get hot, and then adjust the temperature according to the water already in the tub? (In other words, you don't allow the cold water to go down the drain while waiting for it to get hot.)

_____10. Are water leaks repaired quickly in your home (even the dripping faucet)?

_____11. Would you be willing to use a toilet which flushes by using mineral oil, which is then filtered and reused over and over again?

_____12. If you want a drink, do you let the water run to get cold?

_____13. Do you wash dishes in running water?

_____14. If you have an automatic dishwasher, do you wash only full loads?

_____15. Do you let dishes pile up until you have a full load to wash (either by hand or by automatic dishwasher)?

_____16. Do you wash dishes during the mid-morning or late afternoon periods of the day?

_____17. Do you wash clothes only when they are dirty?

_____18. Does your washer size fit your needs (not too large or small)?

_____19. Do you wash small loads at the full water setting?

_____20. Do you reuse sudsy water in your washer?

_____21. If you have a disposal unit, do you use cold water?

_____22. When you wash your car, do you allow the water to run freely until the job is done?

Suggestions (sample)

1 & 2. One should have knowledge of both the origin and the destination of his household water, thereby getting an appreciation of our dependence on it, and the results if we don't care for it and its quality.

3. Due to excessive costs, Tertiary treatment is seldom used in this country, but all waste water should be at least receiving Secondary treatment before it is returned to the waterways.

4. If you don't, you should.

5. It probably wouldn't be advised. It should undergo a purification process before one considers it safe to drink.

6. It is unimaginable that any one of us has ever consumed water which has not been recycled.

7. By all means, turn it off if it's not being used.

8. It is suggested that one uses less water in a brief shower than in a bath.

9. Certainly a wastage of water by allowing the cold water to run down the drain.

10. Gallons can be wasted as a dripping faucet continues to drip away, hour after hour, day after day.

11. This is one of many suggestions for the future disposal of our wastes. It would, you have to admit, save water.

12. Why not store a bottle of water in the refrigerator for this purpose.

13. A waste.

14. You should.

15. Likewise.

16. You shouldn't, for these are hours of peak demand and if it is possible, one should avoid putting any more demands on our water supply than is necessary.

17. Most clothes are worn out not from overuse, but from overwashing.

18. Too large or too small a model will eventually cost you in excessive water usage.

19. Why, when this isn't necessary? Use the water level selector to avoid wasting water.

20. This is a way to conserve water.

21. You should, for cold water gets the grease into the proper form for the disposal unit to work on it; grease hardens as it gets cold.

22. Unless you intend to water the lawn simultaneously, this excess water will needlessly run into the drains.

Submitted by: Richard Nader

Grade Level: 9-12

Title: Water Analysis of a River

Objective(s):

1. To analyze the river water chemically.
2. To determine the contributors of the pollution (industrial, residential).
3. To calculate the ppm of pollutants and minerals.
4. To construct a simple water filter for the water.

Materials:

chemicals necessary for water testing - LaMotte Chemical Test Kit used
materials from which simple filters should be made - open tubes, sand, gravel, stones, charcoal, etc.

Procedures:

1. Students were grouped and given a specific chemical test to perform.
2. After the inorganic materials were identified and the amounts calculated, the groups exchanged materials & data.
3. Discussions of sources of these materials followed.
4. Students designed and constructed water filter and ultimately filtered and distilled it to a drinkable state.

Questions:

1. Why are nitrates and phosphates so harmful to your fresh water supply?
2. What is algae?
3. How will algae effect animal life in water? How will it affect us?
4. What is your conclusion about the effects of detergents on animal life in water?
5. What kind of living organisms will pollute water support?
6. What other ways can our rivers and lakes become polluted?
7. What step(s) should be taken (are being taken) to clean up our polluted water supply?

8. Have students make a checklist of things in their homes that are water pollutants.

Bibliography:

Water for the People. Sarah Friedman, London: Abelard-Schumann Ltd., 1960.

Film: "The River Must Live"

Student materials from various public libraries

Water: The Vital Essence. Peter Briggs, New York: Harper & Row, 1967.

The World of Water. J. Gordon Cook, New York: Dial Press.

Biological Sciences Curriculum Study. Investigating Your Environment. Menlo Park, California: Addison-Wesley, 1975 (grades 7-12)

Submitted by: Arlene Rama

Questions by: Fred Thomas, Creola Powell and Bernice James

Grade Level: 6-12

Title: Temperature Profile of a Snowdrift

Objective(s):

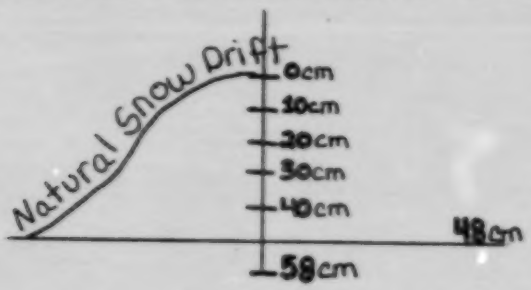
1. To determine the insulating qualities of snow.
2. To show that snow is necessary for small animals and soil invertebrates to survive cold winters.

Materials:

shovel
thermometers (Fahrenheit - smaller calibrations)
meter stick
field notebook

Procedures:

1. In teams of two or three, find a naturally formed snow drift.
2. Measure and record temperature at snow surface.
3. Using a shovel, cut away the first 10 cm of snow.
4. Push the thermometer horizontally into the snow at this depth. Measure and record temperature.
5. Repeat this procedure for every 10 cm of snow. (NOTE: Remove only 10 cm of snow at a time and shove the thermometer into the bank as far as possible. Otherwise, the thermal qualities of the snow will be destroyed before you measure the temperature.)
6. If you are in the woods where the leaf litter is deep, record the temperature directly under the litter.
7. If the soil is soft, record the soil temperature 10 cm under the surface.
8. Return to class and set up a graph of temperature vs. snow depth (0 cm is the top of the snow drift), or use a bar graph to compare air, ground, and snow temperatures at different depths.



Questions:

1. Discuss the importance of snow insulation to small mammals and soil invertebrates during cold temperatures. The graph should provide suitable information for discussion.

2. You may want to repeat this activity several times during the winter. The most dramatic results are obtained on the coldest days.

Submitted by: Patti Lease, Art Durow and John Campbell

Grade Level:

Title: Water Use

Activity:

1. Start out with having students "brainstrom" Chart (A) dealing with average domestic (home) water use in the United States filling in what purposes water is used for in the home and a "quesstimate" of the amount used per day.

AVERAGE DOMESTIC (HOME) WATER USE IN THE UNITED STATES

Purpose	Amount (liters per person per day)	Actual Estimate
Flushing toilets		(78)
Washing and bathing		(70)
Kitchen use		(11)
Drinking water		(10)
Laundry		(8)
General household cleansing		(6)
Gardening		(6)
Washing the car		(2)

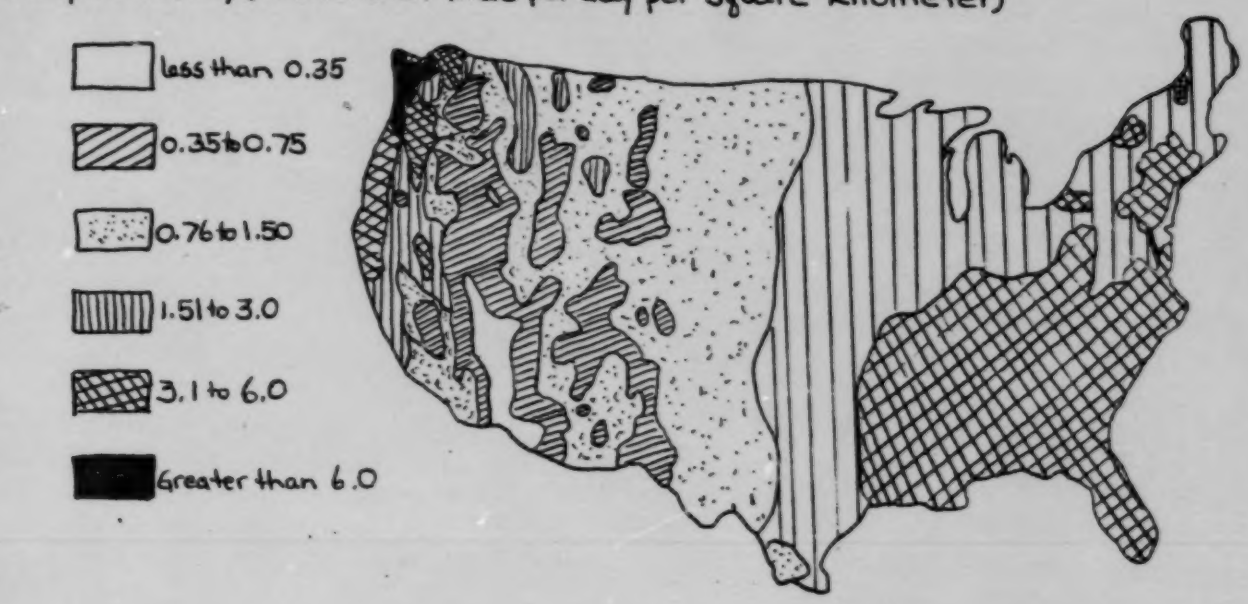
2. Have students investigate, through home-study of their own water meter, the actual water usage occurring in the home. Involves activities on meter reading, computations of findings, and graphong skills (development of).

3. Have students plot the water usage data:

   daily: for the first week
   weekly: for remainder of month
   monthly: for remainder of year

   You now have information to determine (1) peak periods of water usage during the week (propose reasons of why??), (2) peak periods or seasonal changes of water usage during a 9-month period (again...reasons as to why???).

4. Correlate all data with precipitation chart (Chart B).


Precipitation Key (millions of liters per day per square kilometer)
less than 0.35
0.35 to 0.75
0.76 to 1.50
1.51 to 3.0
3.1 to 6.0
Greater than 6.0

Discuss reasons or ideas dealing with:

-effects of water availability
-would students lifestyle (pertaining to water) change if living in different regions
-effects of water surplus vs. water deficiency
-etc.

5. Discuss, brainstorm, etc., ways of saving water.

Adapted from:

The Environmental Science-Probing the Natural World/3. Silver Burdett - General Learning Corporation.

Submitted by: Shirley Walhstrom and Jim Rustowicz

Grade Level: 7-12

Title: Pond Study

Objective(s):

1. To learn about the plants and animals in a fresh water pond community.

2. To better understand the effect that such communities have on our lives.

3. To learn about the predator-prey relationships in the pond.

4. To learn about water quality by the types of organisms inhabiting the water.

Materials:

strainers on poles
collecting jars
thermometers
pails
eye droppers
procelain pans with white bottoms

Procedures:

1. Spend some time in the classroom discussing the various types of invertebrates that live in the pond. One or two class periods may be used, depending on student interest and motivation. Use as many sources of information as you can, such as Pond Life Goldenbook, encyclopedias, Insects Goldenbook, etc.

2. Either take a school bus, or have parents drive to the pond site.

3. Have students with boots and waders get samples near the shore and put them in collecting pans.

4. Sort out the invertebrates and collect them in pails.

5. Return to the classroom for further study.

Questions:

1. When you get to the pond, stand quietly and observe:

   A. What sounds do you hear that are natural?
   B. What sounds do you hear that are man-made?
   C. Which sounds do you perfer? Why?
   D. What is the general layout of the pond?
   E. Do you detect any odor?

2. List and describe any animals that you see:

   A. above the water

B. on the surface
C. in the water
D. on the bottom

3. What characteristics would animals in each of these areas need in order to survive?

Collecting the specimens on the surface of the water:

1. Scoop up some of the surface water and plants with the jars or strainers. Dump this into the porcelain pans and spread the plants. Leave undisturbed and observe. Do you see animals that you did not see before?

2. Using an eye dropper or forceps, place samples of each different kind of animal into a collecting jar and label. Keep the jars in a cool place.

3. Take handfuls of the plant material in the pan and sort through it carefully, collecting any animals that you find.

4. Repeat several times.

Collecting the specimens under the surface of the water:

1. Push the sampling jar or strainer, mouth down, under the surface of the water to a depth about half way between the surface and the bottom. Turn the jar or strainer slowly right side up. Pour this mid-water sample into the porcelain pan. Leave undisturbed and observe. Do you see any animals that you didn't see in the previous sample?

   Are there any animals that you saw before in the previous sample?

2. Using an eye dropper and/or forceps, place samples of each different kind of animal into another collecting jar and label.

Collecting the speciments on the bottom of the pond:

1. Push the sampling jar or strainer, mouth down, into the bottom mud. Turn the jar or strainer slowly right side up, pushing it through the mud as you do so. Pour this bottom sample into the pan. Tilt the pan slowly one way and then the other, several times. Do you see any animals that you did not see before in the previous samples?

   Are there any animals that you saw before in the previous samples?

2. Using a dropper and/or forceps, place samples of each different kind of animal into a third collecting jar and label.

Get several buckets of the pond water at all levels to take back to the classroom.

In the classroom:

1. Pour the contents of the buckets into the porcelain pans. Let it settle, and observe as many types of animals as you can. Use picture keys to identify the animals. Try to get a relative count of the different animals. Store pan in cool place, and leave overnight.

2. Pour the contents of the collecting jars into petri dishes, and view under the microscopes or with a hand lens. Identify the animals using picture keys. List them and sketch any that are not pictured.

Where found	Type (name or sketch)	Describe movement
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

Observations:

1. Does there seem to be any relationship between the nature of each level that you sampled and the number and kinds of organisms there?

2. What purpose might each type of animal or group of animals serve in the pond community?

3. Are there any signs that the environment has been disturbed or polluted? How would alterations affect the survival of the animals?

4. How would the alteration of the pond affect man?

5. List some things we can learn from a study of these animals that might be helpful to us. (Why is it important to know about these animals?)

6. In what ways could pond communities of this kind improve or worsen the quality of our lives?

7. In the upper half, draw a model of the pond community showing the relationships of the plants, animals, and environment.

   In the lower half, construct a model of a human community showing the relationships of man to other organisms and the environment.

   Compare these models noting the similarities and differences.

POND COMMUNITY

HUMAN COMMUNITY

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8. Discuss water, where it is, what forms it is in, its uses and importance to life.

9. Watch the animals in the porcelain pans for one week, each day making a count of each type of animal that is left. At the end of the week, you should have an idea as to which type of animals are predators and which animals are preyed upon.

Bibliography:

Materials taken from field trips at Haven Hill, from a Conservation class at M.S.C. and from field trips I have conducted with my biology and conservation classes.

Submitted by: Barbara Dempster

Grade Level: 9-12

Title: Investigating Sewage Disposal

Objective(s):

1. List three (3) techniques of sewage disposal which have been used in the last 100 years.
2. Identify the method or methods of sewage disposal used in his home.
3. List three diseases spread by improper sewage treatment.
4. Describe how an effective septic system functions.
5. List three effects septic systems have on ecological systems.
6. Describe the biological actions that break down sewage.
7. Describe three neighborhood ecological conditions related to its method of sewage disposal.
8. Compare the operation of a sewage treatment plant to that of a septic tank.
9. Describe an accurate test of septic system efficiency.
10. Diagram the local sewage treatment plant and briefly describe how it treats sewage at each stage.
11. List three (3) major problems associated with the local treatment of sewage.
12. Develop a plan of action to help solve one of the problems identified in 11 above.

Materials:

field trip or speaker on septic tanks
field trip or film strip on sewage treatment plant
water testing equipment
yellow pages and phone
samples of local water and of treated water

Procedures:

1. Review the last 100 years of disposal of human waste.
2. Field trip to the site of an installation or cleaning of a septic tank.
3. Discussion of septic tanks and sewage treatment plant or show film strip.
4. Field trip to a sewage treatment plant.

5. If possible plan a neighborhood septic testing service.

Questions:

1. What are the ecological advantages of each technique?

2. What are the economic advantages of each technique?

3. What happens to the waste in a septic tank?

4. What are the characteristics of a septic system that is operating at peak efficiency?

5. What tests are necessary to show the condition of a septic system?

Bibliography:

Stapp, William B. and Dorothy A. Cox. Environmental Education Activities Manual, Vol. 4 & 5. Published by William B. Stapp and Dorthy A. Cox, 30808 Lamar, Farmington Hills, Michigan 48024, 1974.

Southeast Michigan Council of Governments. Water Quality Memo, 800 Book Building, Detroit, Michigan 48226.

Andrews, William A., editor. A Guide to the Study of Freshwater Ecology. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972.

Submitted by: Jim Urban

CAPSULE IDEAS ON WATER QUALITY

Learn to read a water meter to find the average number of cubic feet of water used each day per household.

Submitted by: Shirley Walstrom and Jim Rustowicz

Study the affects that detergents in the water supply have on germination and seedling growth.

Submitted by: Larry Schulz and James Newman

Discuss how rivers and lakes have the potential to keep themselves continually cleaned with proper consideration. Locate area problems, film, AV materials, etc.

Submitted by: Terrie Merritt

List several ways students individually can save water. Compare lists and arrive at a class consensus.

Submitted by: Cheryll Greene

Make a chart titled, "My Contribution to Water Sewage". Compile statistics over a 24 hour period on using restrooms, watering plants, baths, showers, cooking, etc.

Submitted by: Barbara Porter

Write letters to the Student Conservation Association to provide students with valuable volunteer experiences.

Submitted by: Monica Schulz

Role-playing - committee on water quality versus industry and big business contributing major pollutants to area waterway.

Adapted from: Nature of Cancer, Resource Kit
Submitted by: Linda Gagnon and Pat Burnell

Take color slides of water quality projects developed by industrial arts students to present to other classes.

Submitted by: Bob Delashmit

LAND USE

Grade Level: 9-12

Title: Your City's Natural Areas

Objective(s):

1. After obtaining maps and data the student should become familiar with the city's land use plan regarding parks, natural areas (in this case wooded), and agricultural vacant land by estimating the % their city devotes and plans to devote to these areas.

2. The student should be able to define: biome, home range, territory, and acre.

3. The student should be able to name animals characteristic of the biome in which the student lives.

4. The student should research to determine the size of the home range of five of the mammals in their biome. (This information may be given to them.)

5. Referring to the information obtained in objectives 1 and 4, the student should be able to calculate how many mammals their city can support.

6. After determining if they are satisfied with the % of land their community is devoting to parks and natural areas (in this case wooded areas) the students may take social action by identifying organizations in the city that would support their viewpoint and disseminating information to the organizations through writing or volunteering to speak to them.

Materials:

High School Biology Textbook
Master Park Plan map of the city
Land Use Plan for the city
City's Organizations List (local telephone book - Chamber of Commerce, etc.)

Procedures:

1. A group of students or the teacher should contact the city planning commission and ask them for information on acreage devoted to parks and natural areas (wooded in this case) and acreage devoted to agricultural/vacant land. A map and brochures are usually available. In some cases information may be obtained from zoning boards or other governing bodies.

2. Students are to complete the questions in this activity.

3. Students may decide they want to change the existing plans in their city concerning land use and natural areas. If so, they are to expand on the activities in question 15.

Questions:

1. Imagine you return home from a trip and the entire city in which you live has been destroyed, including your family that live in the city, what could you do? List at least three alternatives.

2. Assume you follow one of the alternative solutions to the problem in question 1, state three problems you would encounter following that solucion.

3. Define: home range, territory, biome, and acre.

4. What biome do you live in?

5. What are some of the organisms characteristically found in your biome?

6. What is the home range (acres) of five of the mammals in your biome?

7. What is the acreage of your city?

8. What % of the acreage in your city is vacant/agricultural?

9. Assuming only one animal of a species occupies the species home range, how many of the animals in question 6 can the vacant/agricultural land support?

10. What does the planning commission plan to do with this land?

11. What will happen to the animals that are located on it?

12. What % of your city's land is devoted to parks, and what % is devoted to natural areas (in this case, what % is devoted to wooded areas {deciduous forest biome})?

13. What is the population of the city in which you live? How much park and natural area is that for each person?

14. What are some reasons for parks and natural areas?

15. Assume you are not satisfied with the % of land your city is devoting to parks and natural areas. You might contact local organizations that are supportive of your desire to increase the acreage devoted to parks and natural areas and give them the information you have accummulated. Form a list of local organizations in Livonia, and place by the organization's name if you think the organization would be supportive, a 0 if it would be indifferent, and a - if it would be opposed, to your desire to increase the % of land devoted to parks and/or natural areas.

Answers to Questions:

1. (Note: Questions 1 and 2 are not meant to be anthropomorphic. However, there are certain parallels in human and non-human behavior, concerning population stress, that could be drawn when one's home range is destroyed.)
Students' answers will vary. Some might be: go to relatives nearby, go to friends nearby, or go to a social agency (police, Church, etc.).

2. Students' answers will vary. Some might be: transportation to get there, lack of room once you got there (need to share a bedroom, finding a cot, etc.), what school to go to, food budget, lack of family interaction, lack of parental help or guidance.

3. Definitions:
home range: area where an animal tends to stay
territory: part of home range an animal defends
biome: large area of earth characterized by soil and climate
acre: plot of land about 200' x 200' or actually 43,560 ft^2 or 1/640 square mile

4. Deciduous Forest Biome

5.,6.,9. (Example of hypothetical chart)

Number of Organisms Theoretically Supported by 4,608 Acres of Vacant/Agricultural Land

Some organisms in a deciduous forest biome	Home range in acres	# vacant/agricultural land can support (median comes)
rabbits		
cottontail	14	329
snowshoe hare	10	461
E. cottontail	3-8 males 2-6 females	838
deer		
earthworms		
porcupines		
squirrels (fox)	10-40	184
mole		
mice	.5-2	3686
shrews	.5-1	6144
snakes		
frogs		
racoons		
skunks	160*	28
foxes		
opossums	11.5	400

Some organisms in a deciduous forest biome	Home range in acres	# vacant/agricultural land can support (median comes)
weasels	2	2304
chipmunks	2-8	921
beavers	8	576
voles	.1-1	9216

7. To be calculated from student data

8. To be calculated from student data

9. See chart in question 5. It is understood that agricultural land cannot necessarily support the same organisms as vacant land. However a breakdown was not available/in this area most of the 20% is vacant and located in one parcel of land.

10. To be calculated from student data

11. The animals will relocate, adapt to other environments, or die.

12. To be calculated from student data

13. To be calculated from student data

14. Some reasons for parks and natural areas could be: recreation, oxygen added to the atmosphere, population stablized therefore, no need for more homes, etc., breeding grounds for certain species, appreciation of nature, education, heritage, enjoyment, food chains to keep organisms in check, right to live philosophy, etc...

Bibliography:

Burt, William H. Mammals of the Great Lakes Region. Ann Arbor, MI, University of Michigan Press, 1957. pp. 222-225

Land Use Plan. Livonia, Michigan, 1975.

Educational Services, National Audobon Society, "Forest Food Chains," 1130 Fifth Avenue, New York, New York 10028

Shane, H.G., interviewed by Barbara Porter, City Planning Dept., Livonia, MI at 4:00 p.m. on March 2, 1978

Submitted by: Barbara Porter

Earth

Grade Level: 7-12

Title: Earth

Objective(s):

1. To develop awareness of litter and it's effects on land.
2. To learn the meaning of new terms; biodegradable, ecology, degradable.
3. To solve the problem of spare lands using it for the good of mankind.

Materials:

shoeboxes
plastic wrap
soil
aluminum foil
toothpicks
tin can
pieces of hair

Procedures:

Introduction:

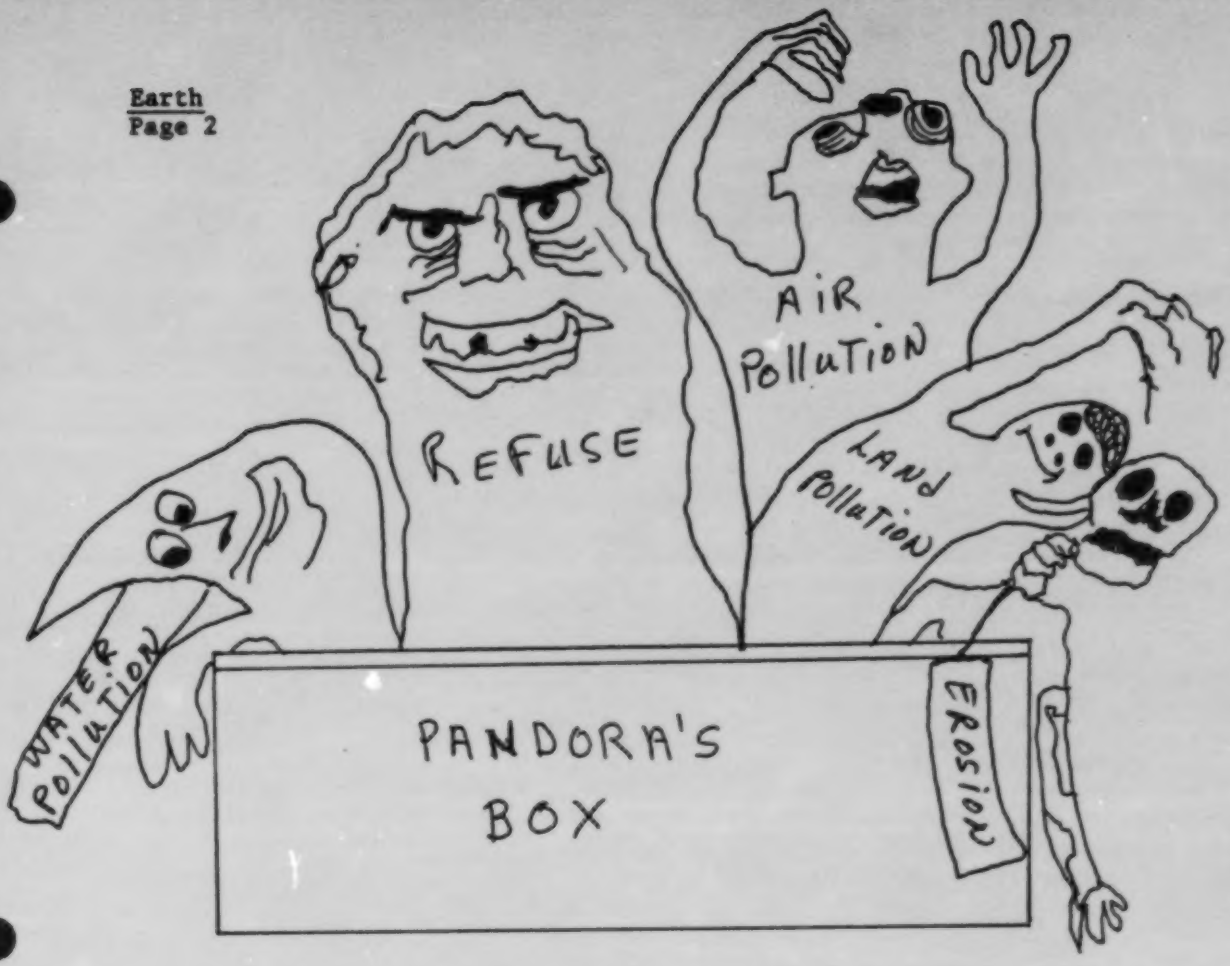
In America, it was with land that man committed the first of his many ecological sins, through his erosion-producing farming practices, and his forest clearing operations.

Today man uses highly advanced technology and accomplishes the same result on a larger scale and manages to pile up more than 100 million tons of refuse on the land every year in the process. Man's creative skill in production emphasizes his meager knowledge of disposal.

The major causes of land pollution are erosion, the indiscriminate clearing, removal, filling in, mining, drilling and paving of land, the widespread use of chemical pesticides and herbicides and the accumulation of industrial, municipal, and domestic waste. Population growth is also a factor which can no longer be ignored.

The effects of land pollution are unsightliness, loss of valuable topsoil for food production, the pollution of waterways by silt deposits, the destruction of wildlife habitats in field, forest, and marsh, the extinction or near extinction of several hundred species, rat-infestations, and the appearance in food of chemicals with which man has had no previous biological experience.

Under certain conditions, land can renew itself, but, as with other natural purifications and renewal processes, time is of major importance. (For example, it takes nature several centuries to build up a six-inch depth of rich topsoil.)



Prepare some table or bulletin board displays.

1. Pandora's Box

2. Pictures mounted on cardboard labeled and placed in a folder (Include pictures of dumps, slums, arid land, farms, factories, abandoned mines, bare hillsides, a forest fire, oil drilling operations, an eagle, a cheetah, rats, a junk yard, piles of debris, etc.)

3. Maps: local outline maps, community land-use map, local road map

4. Charts: some Audubon "Food Chain" charts, mounted on cardboard (inexpensive and may be purchased from the National Audubon Society, 1130 Fifth Ave., New York, N.Y. 10028)

Tell the children the Greek myth about Pandora's Box, stressing the idea that the box had been given to Pandora by Zeus for safe-keeping. Have a general discussion about the legend. Questions: What has been freely given to us and to all people not only for safe-keeping, but for use? (Natural Resources) What are those natural resources? Has man safeguarded his natural resources? Will he ever receive any more resources than what he has right now? Can we throw away this planet and get another one tomorrow?

1. Ask the class to imagine a different ending to Pandora myth, to imagine that air, water, and land pollution were the demons that escaped from the box, to imagine that Pandora was very clever and an excellent problem solver. Write an ending to the story and tell how Pandora rounded up all the demons, put them back in the box, and slammed it shut forever.

2. Take a "litter walk" around the school grounds. Give each group a large bag and designate areas to be covered. Still outdoors, have the children empty the bags and sort the contents. Estimate the number of pieces of paper, bottles, string, etc. and record the estimates. Re-collect the litter and dispose of it.

3. Write the estimates on the chalkboard and have students make bar graphs to show the incidence of certain types of litter on the playground. How much of it was biodegradable? Can they imagine the amount of litter on all the playgrounds in the community? in the state? in the country? in the world? Can some types of litter be called pollutants? What kinds? Ask students to collect the litter in their yards to estimate the indence of certain types, and to prepare a bar graph to compare with the one made in school.

4. Make some "litter gardens" to further establish the concept of biodegradability. Line six or seven shoe boxes with plastic wrap and half fill with soil. Plant two identical rows the long way with four items each. (For example, a hair clip, a piece of plastic, a piece of aluminum foil, and a piece of newspaper in each row.) Use different items in each of the boxes. Identify each piece with a tag on a toothpick. Keep the soil slightly damp at all times.

5. At the end of a week, the students can carefully dig up one row in each box, allowing time between each "dig" for observation to be recorded. At the end of the second week, have them dig up the second row in each box and record observations.

Questions:

1. Which materials showed signs of wearing down?

2. Which materials are biodegradeable?

3. Which ones could pollute the landscape indefinitely?

4. Can materials be "degraded" in any other way?

Biodegradability: The ability of a living organism, or anything that was ever part of a living organism to deteriorate.

Nonbiodegradable: Not capable of deteriorating through decomposition (examples: glass, plastic, aluminum)

Bibliography:

Pollution: A Handbook for Teachers by Dorothy Needham

Creative Moments Investigations, Creative Studies Inc.

Submitted by: Cheryll Greene

Grade Level:

Title: Citizen Action - Land Use

Objective(s):

Students will read articles for obtaining data, decide which side of conflict they will undertake, write letter to editor and try for resolution of problem.

Materials:

mock newspaper handout
materials for students' letters to the editor

Procedures:

In presenting the lesson, the teacher will stress the amount of land available to us today is limited and therefore valuable. To attempt to control land use, most states and communities have established zoning regulations. Land is usually grouped by some classification, such as agricultural, residential, or industrial.

Students will be asked to consider these points:

1. What are the regulations?
2. Is there a planning commission?
3. What information on land use patterns are available?
4. How is the land zoned?
5. Will the proposed action have an effect on individual's life style?
6. What are the consequences for the entire community?
7. Will the various parts of the natural setting be affected?

Students will read the mock newspaper and fill-in data sheet from information they have obtained. Their second task is to pick which group with whom they would identify and state reasons. Finally, their third task is to write and turn-in their final copy of a letter to the editor.

Debriefing:

Students will discuss the various letters to the editor. The final conclusion is the update of this conflict which in reality was a lawsuit involving Citizens for Henry Ford's Wildlife Perserve vs. Ford Motor Land Development Corporation. Suit filed July 30, 1975

Submitted by: Shirley Wahlstrom
Mary LeBlanc

Controversy written in "Dearborn Times Herald". Checked two sides - Mr. Tom Boyle from Ford Motor Public Relation's Dept. and Mr. Jack Smiley, Spokesman from wildlife group.

WHOSE LAND

In this day of rapid expansion, land usage soon becomes a concern to all. What are the rights of land owners? How can average citizens be protected from poor land usage? Does big business owe the community certain environmental protections against mismanagement of land? How effective are pressure groups? These are but a few of the issues that are now being undertaken in court.

Many citizens have become greatly concerned and in fact one pressure group representing environmental interests has organized and is now in court. Their contention is that the big corporation can well afford to give up a portion of land to the community in the name of conservation. The group further claims that hugh corporations that pollute should compensate society for damage they have done in other areas.

The debate rests that the 206 acres of land are needed for natural balance because the surrounding land is being developed quickly, and population density is increasing.

The other side of the conflict finds big business claiming it should be able to use land as it desires, since it owns and has paid taxes on the 206 acres of land for 25 years. Also, they feel they have a good environmental policy and claims it has replanted trees and vegetation, and otherwise used the land it has already developed in the area in an ecologically sound way. The land is zoned for commercial use and the corporation feels the suit is unfair in that it is confiscation of land.

STUDENT DATA SHEET

Read the newspaper article and take notes for each group.

1.

Environmental Pressure Group	Big Business

2. Reasons for joining _____ Group:

3. Rough draft of your "letter to the editor"

Grade Level: 7-12

Title: Investigating Residential Land Use

Objective(s):

1. To draw a map of the students home and the area around the house.
2. To study the uses and alternative uses of land in residential areas.
3. To study the aesthetic and functional values involved in land use.
4. To formulate alternate ways of using residential land.
5. To seek out community services as an information source.
6. To investigate local ordinances that effect land use.

Materials:

paper
pencil
telephone book to look up numbers of local officials
telephone

Procedures:

I. Have students map their home and the area around their home to show how the land is used.

Include the following: home, land around the home, garage and other buildings, flower gardens, vegetable gardens, shrubs, trees (show type), concrete drives, walks, patios, fences, utility poles, grass, recreation areas, roads, and indicate number of cars

II. Student survey of uses of their residence.

Have students list uses of their home and land that add to its' beauty and comfort, and those that are basicly functional.

Adapted from: Spaceship Earth by William Stapp and Dorothy Cox

Submitted by: Jim Urban

Grade Level: 7-12

Title: Where is This Car Going?

Objective(s):

1. To increase student awareness of the need for and the processes involved in recycling solid waste.

2. After completing the activity, the students will be able to:

   a. Describe at least one way to recycle each of these materials:

steel	rubber
glass	platinum
plastic	copper
aluminum	lead

   b. Explain how and why complex machines such as automobiles are dismantled and their components reused most efficiently in an advanced society such as ours.

   c. Describe the economic reasons for recycling automobile components.

   d. Explain how recycling of automobile components saves valuable natural resources.

Procedures:

Activity #1

Divide the class into groups of five or six. Give each set of students a picture of a wrecked car and a description of its condition. The learners are told that they must dispose of the car. Have them call a junkyard to find out how much it is worth. Have students check the "salvage and auto parts - miscellaneous" section of the newspaper to find out which parts may be resaleable and at what prices. Students should call a scrap yard to find the price of scrap steel, cast iron, lead, aluminum and copper. When they have this information, have them make a chart to show which parts they would have sold and scrapped and how much money they could have received. The completed chart should look something like this:

PART	SCRAP	RESALE	SELLING PRICE
Left door		x	$ 25.00
Radiator	x		4.00
Starter	x		1.50
Alternator	x		1.50
Windshield wiper motor		x	15.00
Engine	x		5.00
Transmission		x	30.00
Left front fender		x	25.00
Bumper (front)		x	15.00
Body (whats left)	x		15.00
Battery	x		2.00
One good tire		x	15.00
			$154.00

Questions for Activity #1 (possible student responses in *italics*)

1. What advantages are there to disposing of a car by abandoning it where it stops?

   A. *There is no towing fee*
   B. *There is no bother*

2. What advantages are there to selling it to a junk yard for a nominal fee?

   A. *Most times there is no towing fee*
   B. *There is no bother*

3. What advantages are there to scrapping it?

   A. *The seller can make money*
   B. *You are less likely to contribute to the solid waste disposal problem*
   C. *The scrapped parts save natural resources*

4. What disadvantages are there to scrapping it?

   A. *There may be a towing fee and a fee to run the ad in the newspaper*
   B. *You may have to remove the parts to sell them*
   C. *Stripped cars in the yard are an eyesore and neighbors may complain*
   D. *It may be illegal in your community to strip cars in the yard*

5. How might some of these disadvantages be overcome?

   A. *Use local newspapers, community bulletin boards to advertise it for sale*
   B. *Sell parts cheaper and have the buyer remove them*
   C. *Have the junk car towed to your garage or rent one in the neighborhood and remove and sell the saleable parts*

6. If your 13 year old car stops on the expressway, what would you do with it?

Activity #2

Have a large picture of a car in front of the class. Ask the students to brainstorm which parts of the car can be reused, which rebuilt, and which recycled. Make a large chart:

REUSED	REBUILT	RECYCLED
hub caps fenders windshields (other student suggestions)	radiator starter motor engine (other student suggestions)	steel in body glass (other student suggestions)

When the students have listed all of their contributions, make sure that the "recycled" column has representatives of the following materials: steel, glass, plastic, aluminum, rubber, platinum, and copper.

Break the class into groups and assign each a material from the "recycled" column on which to report. Each group should then brainstorm and research until it can describe how its material can be recycled. Students should also be able to explain why and how often its material is recycled in our society.

Complementary Activities

1. Field trips to auto plant, junk yard, recycling plant, etc.

2. Films and filmstrips showing how cars are manufactured and disposed of such as G.M.'s "A Car is Born" and Ford's "Ford Rouge."

3. Have the current per pound prices of various recycleable materials available: what price reclamation facilities will pay for materials coming in and current market prices of the materials ready for sale to manufacturers.

Submitted by: Dan Oden

Grade Level: 7-12

Title: A Simulated Land Use Problem and Activity

Objective(s):

To develop an understanding of the sociological, economic and environmental problems associated with the rezoning of property.

Procedures:

Background Information

Austin Township is located in a rural area of Southeastern Michigan approximately 30 miles west of the City of Detroit. The total population of the township numbers almost 5,000 people. In the thirty-six square miles are located two small villages with populations of fewer than 500 individuals. A large percentage of the residents are employed by the auto industry. Also living in the area are many general and produce farmers. Other occupations run the range from service oriented jobs to professional people.

Over the past thirty years, the population growth has been slow but steady. There have been no housing developments or apartments built in the township and trailer courts are banned by the zoning ordinances. The population growth has been the result of families leaving urban areas and building single family dwellings on acre to two acre plots.

The land which would be considered desirable for development purposes is largely owned by long time resident farmers who are holding onto the land in hopes of passing it on to family members. The attitude toward growth in the township is somewhat ambivalent with most residents wishing to maintain the rural atmosphere and sensing that there would be more problems than benefits to an increased population.

Problem:

Mr. Tom Smith appeared before the zoning commission at its regularly scheduled meeting to request the rezoning of 400 acres. Mr. Smith explained that he is the principal owner of the Southeastern Michigan Development Company which owns the land. The rezoning requested is from agricultural to residential so that Mr. Smith's company can build a housing development. Mr. Smith showed the zoning board several illustrations of the developers intentions. Basically the company's plans are to build homes in the area (3 to 4 per acre) and to construct several condominiums.

Sam Goodall, the zoning board chairman, explained to Mr. Smith that his rezoning request was now on file and that a public hearing is held on all zoning changes. The hearing is required by law so that any person or persons wishing to might have the opportunity to speak either in opposition or in favor of the change. The notice of the public hearing and its purpose appeared in the township board's official newspaper.

Upon publication of the public hearing notice, several area residents became very upset about this type of growth in their rural area. Mr. John Stable became a self-appointed leader of the opposition and invited many residents of the township to a meeting at his home. The Austin Homeowners Association was the result of the meeting. The association printed a flyer (see attachment) opposing the rezoning which was delivered to every home in the township.

Procedure:

The public hearing is chaired by the zoning board chairman, Mr. Goodall. The five member board hears the statements of all persons interested in making a testimony. Following the hearing the zoning board convenes a closed meeting from which a decision about the rezoning must be announced.

Participants:

Rezoning Board:

Sam Goodall, Chairman
- Occupation: Automotive Engineer
- Length of Residency: Five Years
- Pertinent Data: Mr. Goodall is serving on the zoning board because he feels it is his civic duty. He has no political ambitions and will not gain or lose depending on the decision reached. Considered by many to be the swing vote.

Richard Rock
- Occupation: Produce Farmer
- Length of Residency: The Rock family is one of Austin Townships oldest families, having settled in the area in 1836.
- Pertinent Data: Mr. Rock enjoys the freedom of living in a rural area. He takes pride in keeping his farm area free of new residents. He believes that the quality of life in the township will suffer if new developments are approved.

Reverend Josiah Jones
- Occupation: Protestant Minister
- Length of Residency: Ten Years
- Pertinent Data: The membership in Reverend Jones' church has declined steadily over the past three years. He sees the salvation of his church to be linked to growth in the community.

Frederick Birdsall
- Occupation: Regional Director of the Department of Natural Resources
- Length of Residency: Three Years
- Pertinent Data: Mr. Birdsall is an avowed environmentalist. He believes that the housing development will destroy the drainage pattern in the area and disrupt many forms of wild life and vegetations.

George Greed

Occupation: Automotive Employee
Length of Residency: Life Long
Pertinent Data: George's brother-in-law by a previous marriage owns a large tract of land adjacent to the proposed development site. It is rumored that George also has a financial interest in this land.

Speakers (Citizens Offering Testimony):

Bernard Longwind

Bernard's family settled in the area in the mid 1800's. He is very proud of his centennial farm. He feels that his ancestors helped to make the land suitable for agricultural purposes and that this is the way it should remain.

Walter Lucket

Walter is the Superintendent of the area school system. He has mixed emotions about the land development. Presently the schools are at enrollment capacity and a large influx of students would require a bond issue. He does realize that his school system like others in the area will eventually reach the declining enrollment stage and that ultimately the development of township properties must take place for the schools to remain stable.

Tom Smith

Mr. Smith is a self made multi millionaire whose fortune was built through his ownership of a large company in a nearby city. Tom formerly resides in the township and acquired the land in question at that time. He is sincere in his belief that his efforts to develop the land will benefit the township.

Alvin Struthers

Alvin is a civil engineer employed by the Southeastern Michigan Development Company. He is well prepared with answers on drainage, sewage disposal, source of water and all other matters dealing with the proposed development.

Cynthia Lovelace

Miss Lovelace moved to Austin Township three years ago because she wished to find a place where she could commune with nature. Her home is on Bemis Road next to the development. She has been accustomed to long walks through the affected property for the purpose of observing her beloved wildlife.

Activities:

Students will assume the roles of the zoning board and of the speakers. The chairman of the zoning board will call the meeting to order and allow each speaker to make his presentation. The speakers can be questioned by the board at the time of their testimony and can be recalled after for further statements after all five have spoken.

The zoning board will then convene a closed meeting. The decision can be reached through a simple majority vote. The decision regarding the rezoning shall be announced to the class at the close of the class vote on the issue while the zoning board holds its closed session.

Questions:

1. What are some of the potential effects on a community when rezoning is comtemplated?

2. What should be considered of primary importance, conservation of land or man's economic and personal need for land development?

Submitted by: Jim Potter

Grade Level:

Title: Three Simulations of Natural Waste Treatment

ACTIVITY I:

Objective(s):

To construct and operate a clarifier, which is used to remove suspended solids by settling (sedimentation).

Materials:

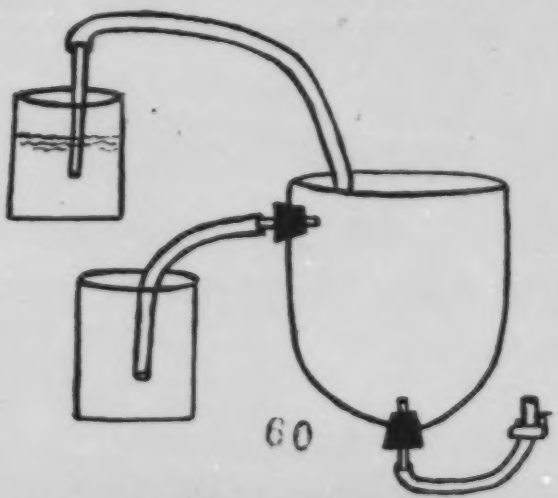
plastic bleach bottle (one gallon)
two rubber stoppers (to fit openings)
rubber tubing (4-6 ft.)
razor blade
glass tubing - two short pieces
waste water storage container
treated waste storage container
water
few handfulls of dirt
cork borers
tubing clamps
ring stand
clamps or rings

Procedures:

1. Cut and fit bottle as indicated in the drawing. Bore holes through bottle and rubber stoppers. Fit stoppers and glass tubing into bored holes and the bottle opening.

2. Connect rubber tubing to glass fittings. Fill waste water storage container with water and add dirt. Mix thoroughly. Establish siphon feed to clarifier and effluent tube to the treated waste storage container.

3. Compare waste water in the clarifier with the overflow or treated effluent. Remove clamp from bottom tubing and collect the matter which flows out. It may plug with dirt from the bottom. Filter effluent.



Discussion:

Compare the influent quality with the effluent quality visually. Is there any improvement in clarity? Does this appear to be adequate treatment for drinking water? Does this appear to be a natural or artificial means of water treatment? How can the system be improved upon?

Terminology:

suspended solids	influent
filtration	effluent
clarification	sedimentation

ACTIVITY II:

Objective(s):

To explore the effects of percolation as a water treatment method by constructing a classroom model. "Percolation" is a natural process by which water is filtered several times by various soils in its passage from the surface to the water table.

Materials:

glass or plastic cylinder 12"-24" deep and about 6" or greater in diameter
wire or plastic window screen to cover one end of cylinder
2-3 ft. of wire to fasten screen to cylinder
coarse gravel
pea gravel
coarse sand — sufficient for about 2-4" depth of each in cylinder
fine sand
about 1 gal. of dirty dish water or run-off from grassy area

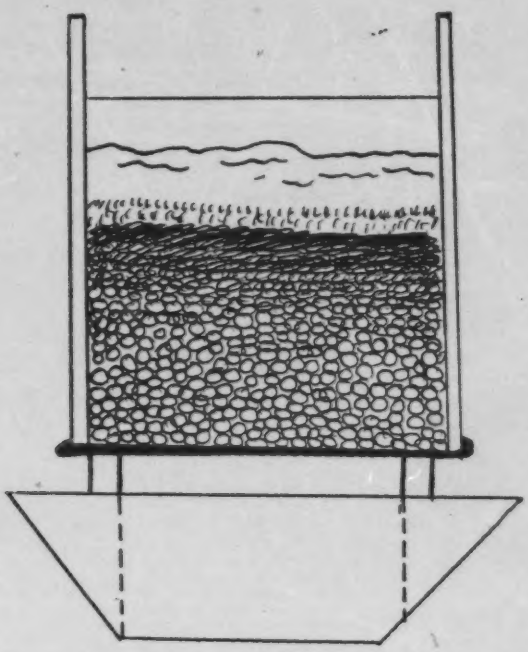
Procedures:

1. Fasten window screen securely over one end of the cylinder with the wire.

2. Add layers of gravel and sand, from coarsest to finest.

3. Place a collection container under the cylinder and pour the dirty water into the top of the cylinder.

4. Collect water for examination as to clarity and appearance.



Discussion:

How is the collected water different from the original sample? Does this method of water purification occur naturally? Would it most likely be found in a stream, lake, bog, or grassy area? (Refer to the definition of percolation.) Must the influent "soak into" the layers of sediment in order for this process to operate? Why or why not?

Terminology:

suspended solids
sedimentation
filtration
clarity
percolation
porosity
capillarity
permeability

ACTIVITY III:

Objective(s):

To explore the effects of the boilogical trickling filter as a waste treatment method by constructing a working model. Biological trickling filtration is a natural process by which bacteria take pollutants from waste material and oxygen from the air and oxidize these materials to CO_2 and H_2O

Materials:

1 gallon plastic bleach bottle
crushed rock (enough to nearly fill bottle)
containers for influent and effluent
rubber tubing (2-3 ft. long)
tubing clamp

Procedures:

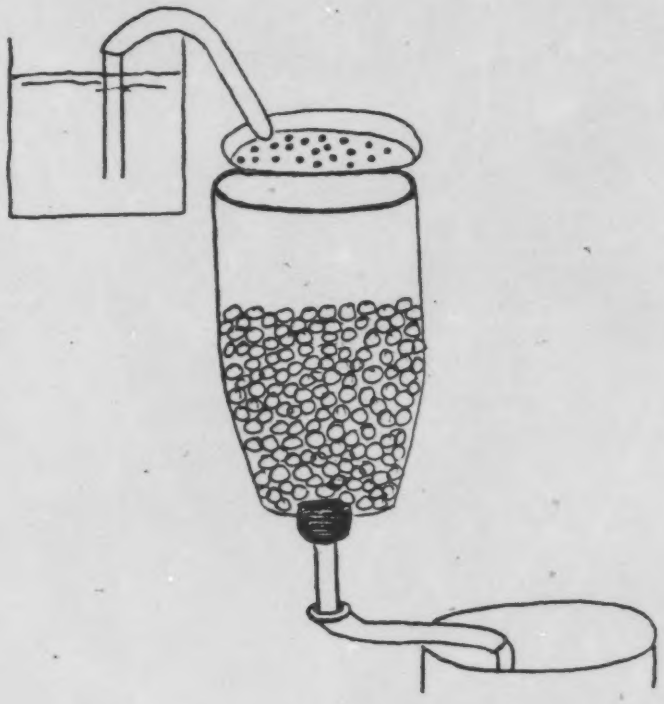
1. Cut bottom off the bottle about 1" from the bottom. With a nail, punch holes in the bottom in such a manner as to distribute them evenly over the bottom surface but not closer than ½" from the outside edge.

2. Invert bottle, place in a holder, fill with crushed rock almost to the top.

3. Place effluent container under the bottle opening.

4. Establish a siphon from the waste feed container to the inverted bottom of the bottle. (This is now the top of the inverted bottle.)

5. Continue flow of water by recycling until a growth of bacteria (slime) is noted on the rocks and the apparent quality (clarity and odor) of the effluent is good.



Discussion:

Compare the quality of influent and effluent. Besides the obvious clarity and odor comparison, try to check pH and other factors. How were the bacteria introduced into the system? What changes did you notice in regard to the bacterial growths? Is there any apparent improvement in water quality? Would you drink the effluent? Is this method an adequate treatment for water?

Bibliography:

"Environmental Involvement - A Teacher's Guide", Dow Chemical, Midland, Michigan, 1971.

Submitted by: Liz Rashid

CAPSULE IDEAS ON LAND USE

Discuss the problem: Should a real estate subdivision be allowed to take over a large area of swampland formerly used by many of the citizens for duck hunting?

Submitted by: C. Powell, B. James, and F. Thomas

Have students make simple chemical tests on soil to determine nutrient deficiencies. Correct deficiencies and plant seeds. Also plant seeds in untreated soil for comparison.

Submitted by: Tom Tristani

Have students contrast and compare different aspects of landscape architecture and its use by looking at posters featuring forests, mountains, lakes, plains, and cities.

Submitted by: Terrie Merritt and Margaret Raglin

Through the assumption of various roles; such as zoning commission members, residents, land developers, and city council members, the students will be able to discuss problems and solutions involved in the decision making process of land usages.

Submitted by: Pat Burnell, Linda Gagnon, Jim Newman, and Larry Schultz

Have students work on the "Planning Commission" for a new town of three hundred inhabitants. Students are to map out areas for one family homes, apartment buildings, some stores, offices, and an elementary school building.

Submitted by: Julie McDonnell

Make silk screen posters to demonstrate land use problems.

Submitted by: Monica Schultz, Vincent DeSanto, and Bob Delashmit

Students are to plan their dream home. They should take into consideration land use problems of water table, soil tests, well, sewage, power, wind, sun, asthetic view, and landscaping.

Submitted by: Dean Lande

Role-playing - (land use). Committee versus industry and big business.

Adapted from: Nature of Cancer, Resource Kit
Submitted by: Linda Gagnon and Pat Burnell

Investigate the use and misuse of a flood plain and suggest suitable land use policies and procedures for the flood plain.

Submitted by: Liz Rashid

Have students map out school grounds. They can then redesign parts of the school's land.

Submitted by: Randy Mikula

AIR

Grade Level: 6-12

Title: Collecting and Comparing Amounts of Vehicle Particulate Emissions

Objective(s):

The student shall collect particulate matter from vehicles and compare the quantity emitted by different vehicles.

Materials:

cardboard (approx. 8" x 12")
ruler
scissors
tacks
data card
microscope
kleenex
felt pen & graph transparency if it is an overnight assignment or
scotch tape and graph paper if the assignment is completed within the class period*

Procedures:

1. Record the following information on data card for each vehicle tested: your name, number of car tested, year, company (Ford), type (motorcycle, Sedan, coupe), number of cylinders, fuel type (regular, no-lead or ethyl).

2. Prepare collector:

   Type A - Cut Kleenex tissue in four pieces and tack one piece to bottom of cardboard. With the felt pen label the corner of the kleenex with the number of the car you are testing.

   Type B - Cut a piece of graph paper three inches square. Hang three-four inch pieces of tape, sticky side towards you, from a ruler. The pieces should be about ½" apart. Lay the tape on the graph paper, sticky side up, and connect them with a piece of tape on the top and bottom, sticky side down. Remove the ruler and trim the pieces of tape. Attach the collector to the cardboard with four tacks.

3. Let the vehicle run for one minute or until it stops racing.

4. Hold the collector six inches from the exhaust pipe (if two tail-pipes, only use one and multiply the results by two) for one minute. BE CAREFUL NOT TO BREATHE IN FUMES! HOLD HEAD AWAY MUST BE DONE OUTDOORS.

*Graph paper and tape proved a more accurate collector but it is difficult to transport and contaminates if it is a homework assignment and it is not stored properly. Kleenex proved to be a less accurate collector but may be folded in half and stored in an envelope until ready to use.

5. Count the number of particles in three squares and average for one. If the Kleenex method was used, place the graph transparency under the Kleenex on the microscope stage. The microscope must be used for counting, since many of the particles are very small.

Questions:

1. Which vehicle year emitted the most particles?
2. Which company's vehicle emitted the most particles?
3. Which number of cylinders emitted the most particles?
4. Which fuel type emitted the most particles?
5. Which type of vehicle emitted the most particles?
6. Considering all factors, which vehicle emitted the most particles?
7. What are some alternatives to the internal combustion engine?
8. What are some gaseous pollutants emitted by vehicles?
9. What is the EPA doing to control vehicle emissions?
10. What can you personally do to lessen vehicle emissions?

Answers to Questions:

(Answers to questions one through six will depend upon what type of vehicles were tested.)

7. Some alternative are: engines burning natural gas (liquified form) or hydrogen, turbine engines for trucks and buses, and autos run by electric batteries.
8. Some gaseous pollutants emitted by vehicles are: carbon monoxide, sulfur dioxide, nitrogen dioxide, and hydrocarbons.
9. This will vary according to locality.
10. Some personal activities to lessen car pollution might be: to car pool, to walk or ride a bicycle, to purchase cars that meet standards, and have your automobile properly tuned.

Additional Teacher Notes:

1. Of the thirty-seven million tons of particulates emitted eacy year, one million tons come from automobiles.
2. By 1980 High School automotive classes will probably have a Infru-Red Exhaust Performance Analyzer. It would be worthwhile to have a group of students interested in autos learn to use it and report their results to the class. It measures carbon monoxide and hydro-carbon emission.

3. Copy of data card to be distributed to students:

Name _____

Number _____

Year _____ Company _____

Type _____

Number of Cylinders _____

Fuel Type _____

4. In cars tested by author, the number of particles per six square millimeters varied from twenty to eight hundred sixty six.

Submitted by: Barbara Porter

Grade Level: 7-12

Title: Measuring Ambient Air Quality: Lichen Survey

Objective(s):

1. To introduce students to mapping skills.
2. To learn the primary types of lichens.
3. To collect and analyze data gained from a lichen survey.
4. To measure air pollution in one's local community (e.g., St. Clair Shores) using a simple scale based on the growth of lichens.

Materials:

area map from urban area such as St. Clair Shores
Pocket Guide to Plants
Lichen Key
map of rural area such as Stoney Creek Park
handlens
pencil
meter stick
lined paper

Procedures:

We will be taking several "mini" field trips during this Lichen Survey. During these trips around our community you will be responsible for the finding, locating, and identifying of lichens. To do this you will examine all of the trees and rocks that are in the parks, or near the sidewalks for the presence of any type of lichen. PLEASE REMEMBER NOT TO WALK ON ANYONES GRASS OR GARDEN! Once you have found a lichen you are to indicate its location with a number on your map and next to this number on the lined paper you are to record its identification and the height it is located off the ground. Use the Lichen Key, Guide to Plants, and handlens to aid in the identification.

Once we have covered the map areas, complete the pollution survey below.

	RURAL AREA Stoney Creek Park	URBAN AREA St. Clair Shores, MI
Number of Crustose species	_____	_____
Number of Foliose species	_____	_____
Number of Fruticose species	_____	_____
POLLUTION INDEX		
Highest Pollution Number	_____	_____
*5 or more lichens growing over 1.8 m add 1/2 point	_____	_____

8 to 15 foliose and fruticose species add 1/2 point	_____	_____
More than 15 foliose and fruticose species add 1 point	_____	_____
TOTAL - POLLUTION INDEX	_____	_____

*Air several feet above the ground moves faster meaning that more pollutants come in contact with the lichen. If lichens grow this high it means less pollution.

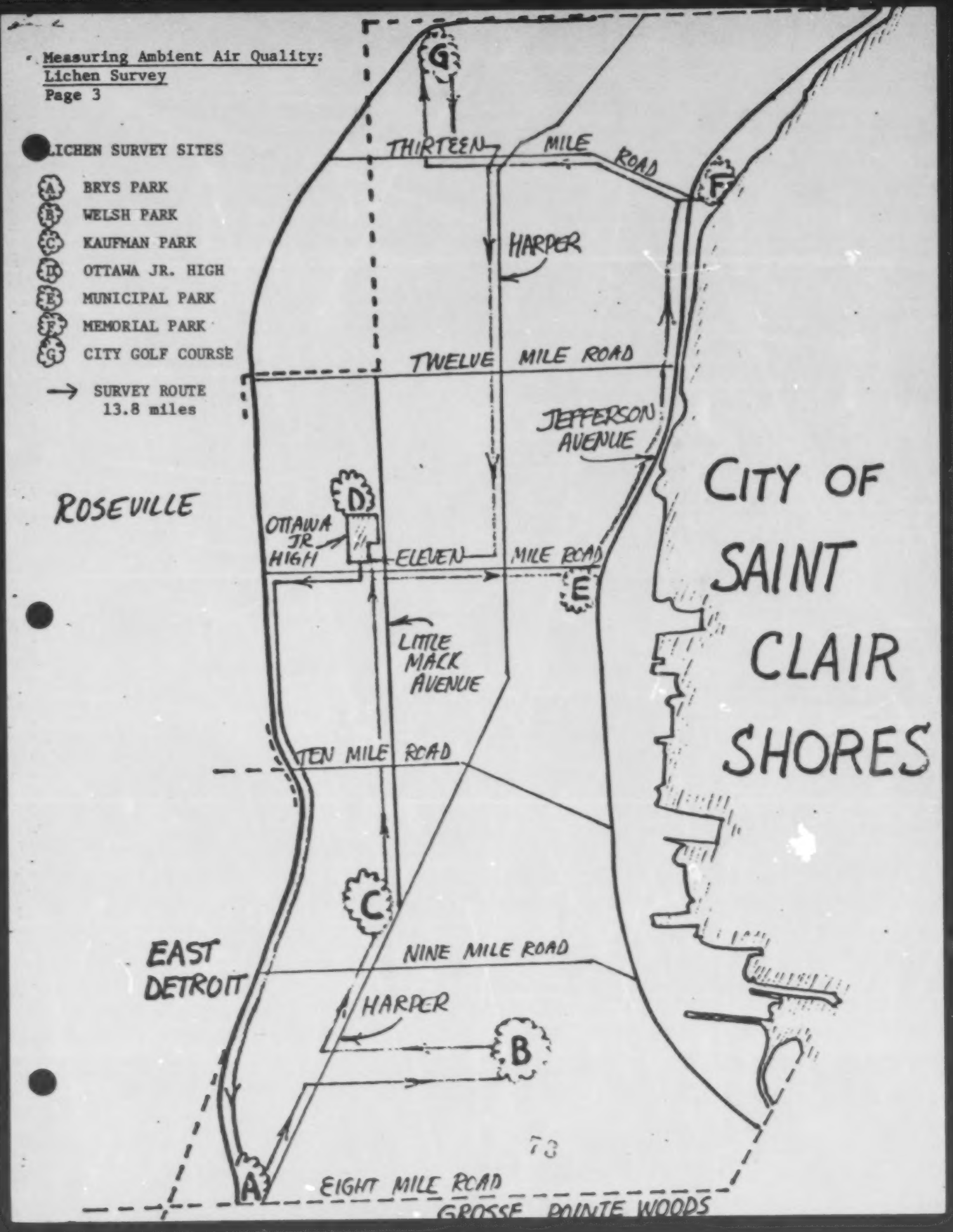
POLLUTION SCALE

0	Badly Polluted
1	Heavily Polluted
2	Moderately Polluted
3	Average Pollution
4	Almost Clean Air
5	Very Clean Air

Bibliography:

Current Science, May, 1975

Submitted by: Larry Schulz and James Newman


LICHEN SURVEY SITES
A BRYS PARK
B WELSH PARK
C KAUFMAN PARK
D OTTAWA JR. HIGH
E MUNICIPAL PARK
F MEMORIAL PARK
G CITY GOLF COURSE
SURVEY ROUTE
13.8 miles
THIRTEEN MILE ROAD
HARPER
TWELVE MILE ROAD
JEFFERSON AVENUE
ROSEVILLE
CITY OF SAINT CLAIR SHORES
OTTAWA JR HIGH
ELEVEN MILE ROAD
LITTLE MACK AVENUE
TEN MILE ROAD
EAST DETROIT
NINE MILE ROAD
HARPER
EIGHT MILE ROAD
GROSSE POINTE WOODS

LICHEN KEY

Structures to Know:

Soredia - masses of mixed fungi and algae found on the surface, may be round or long and narrow. They are flat on the surface. You will need your handlens.

Isidia - are little fingerlike projections that stick up from the surface, a handlens is required to see Isidia.

Rhizines - clear or blackened strands that anchor the plant to a tree or rock, may be a few or many.

Apothecia - visible without a handlens. They are cup or disk-shaped structures normally filled with spores.

You will have no trouble determining the general groups of lichens, this key will give you hints on what features to use in separating species. For example, if two lichens are identical, but one has soredia and the second does not, you have two different species.

CRUSTOSE - The Crusty Ones (most resistant to pollution)

Dimelaena - flat rock-hugging, surface has small distinct areas like a brick sidewalk. Pollution #1

Cyphelium - similar to Dimelaena but with oval apothecia. Pollution #1

All Crustose will have a Pollution # of 1

FOLIOSE - The Leafy Ones (grow in patches up to 30 cm wide, have broad, flat lobes. In general if two foliose are not identical in their features they are different species.)

Phyacia nillegrans - looks like snowflakes, has ashy white underside, brown cells in apothecia. Pollution #2

Xanthoria candelania - conspicuous orange, finely divided lobes less than 1 mm wide. Pollution #2

Hypogymnia physodes - inflated hollow lobes, tiny holes in lobes soredia in hollow tips of lobes, common on evergreens and fence posts. Pollution #2

Parmelia szxatilis - black underside, isidia are course and granular, fine hairs on bottom, fine white angular markings on lobe tips. Pollution #3

Parmelia rudects - round white pores on the lobe tips, light tan underside, isidia dense in center. Pollution #3

Parmelia caperata - pale greenish yellow, black underside, fringes with rhizines, soredia are conspicuous and are often diffused and granular, no white pores on lobe tips, (cylindrical isidia means you have Parmelia conspera). Pollution #3

Umbilicaria mammulata - smooth surface with radial grooves near edge, dense rhizines. Pollution #4

Umbilicaria papulosa - lacks rhizines, apothecia are common. Pollution #4

Lobaria pulmonaria - lower surface mottled brown and white, top light brownish green, turns bright green when wet. Pollution #4

If in doubt with a Foliose give a Pollution # of 3.

FRUTICOSE - Many Branches (high sensitivity to pollution all but the Cladonia, see below, have a Pollution #5).

Cladonia chlorophaea - 1.3 cm high, cup shaped, soredia on cup are granular, apothecia on cup rim. Pollution #1

Usnea - over 20 species that are hard to identify, look like long strands of hair. Pollution #5

Ramalina farinacea - flattened branches, grow erect when young then bend over. Pollution #5

Grade Level: 7-9

Title: Automotive Air Pollution

Objective(s):

Upon completion of this exercise the student...

...will realize that the combustion engine is a major source of air pollution.
...will be aware that automobile ownership and usage is increasing.
...will be given experience in transferring information contained in a table to a bar graph and line graph.
...will use a graph to determine present trends in auto usage, make predictions, and infer possible ideas.
...will utilize vocabulary of air pollution.

Materials:

lab sheet
graph paper
pencils (red, blue, black)
vocabulary worksheet
word search

Preliminaries:

1. Brief discussion on workings of internal combustion engine.

2. Brief knowledge of pollutants (CO, Hydrocarbons, etc.).

3. Basic graphing skills.

Name_____

It has been said that up to 50% of the air pollution produced today is the result of the automobile and its combustion engine. Car engines are known to be producers of carbon monoxide (CO), hydrocarbons, nitrogen oxides, sulfur oxides, and solid particles to list a few. The following chart shows the average amount of pollutants produced by a combustion engine consuming one gallon of fuel.

AIR POLLUTANTS PRODUCED BY A COMBUSTION ENGINE
CONSUMING ONE GALLON OF FUEL

POLLUTANTS	QUANTITY OF POLLUTANT (in grams)
Carbon Monoxide	1139.6
Nitrogen Oxides	88.8
Hydrocarbons	63.2
Sulfur Oxides	4.0
Solid Particles	5.2

The table below shows the relationship of the five major sources of air pollution. These five sources account for over 180 billion kilograms of waste materials dumped into our air each year.

AIR POLLUTANTS (Year)

Source	Pollutants Produced (billion kg)	%
Transportation (cars, trucks, etc.)	82.3	43.4
Electric Power Plants & Heat	37.2	19.6
Industry	26.4	13.9
Burning	9.8	5.1
Misc. (fires)	33.5	18.0
TOTALS	189.2	100.0

Automobile usage in the United States is up! Examine the following chart and plot its information in the form of a bar graph. (X-axis denotes the year and the Y-axis denotes number of registrations.)

MOTOR VEHICLE REGISTRATIONS (millions)

	1950	1955	1960	1965	1970*
Cars, trucks, buses, motor-cycles, etc.	49.5	63.0	75.0	91.7	105.0

*data estimated

Approximately 80% of all american families own cars. In fact, 30% of them own two or more! The chart below adds more information to be considered when discussing automobile ownership. Plot the information from this chart on a line graph. Let the X-axis show years and the Y-axis the percent of families. Draw a black line to show families owning automobiles. Draw a red line showing the number of families owning one car and draw a blue line showing the number of families owning two or more cars. Examine your results.

AUTOMOBILE OWNERSHIP

	1950	1955	1960	1965	1970
Total # of Families	45.2	49.1	53.4	58.5	63.7
Families owning automobiles	59%	70%	77%	79%	80%
Families owning one automobile	52%	60%	62%	55%	50%
Families owning two or more automobiles	7%	10%	15%	24%	30%

Analysis:

What is the trend in the number of motor vehicle registered in the U.S.? Predict how many vehicles will be register in the U.S. in 1975? 1980?

Explain why there is a decrease in families owning one car occurred in 1965 and 1970?

Predict how many families will own two or more cars in 1975.

What effect(s) would limiting the number of automobiles produced, in order to help control air pollution have on your family? on your town? on Michigan and the United States?

If present trends in the number of motor vehicle registrations and automobile ownership continue what possible problems do you see us facing 25 years from now in the area of air pollution?

Bibliography:

Environmental Science, Level III, Probing the Natural World, Silver Burdett.

Submitted by: Jim Rustowicz and Shirley Wahlstrom

News Article by: DETROIT FREE PRESS

EPA LAUNCHES RESEARCH ON DIESEL EXHAUST

WASHINGTON-(AP)-The Environmental Protection Agency is launching a major research program to determine if the exhaust fumes from the nation's diesel-burning trucks and buses can cause cancer.

The agency, in announcing its plans for the investigation, said preliminary findings indicate diesel exhausts cause genetic changes in bacteria and that the mutated bacteria could have cancer-causing capabilities.

Most large trucks, buses and some private automobiles use diesel fuel, but the agency said it was not issuing a health warning to drivers or passengers.

"At this time, we do not have sufficient data to make any reasonable assessment of the public health risk, if any, that might be associated with emissions from diesel-powered vehicles presently operating on the road," said Dr. Delbert Barth, the agency's deputy assistant administrator for health and ecological effects.

But Barth recommended that anyone who works with diesel exhausts take precautions to minimize contact and said the exhausts should be considered "potentially hazardous materials."

The decision to conduct further research follows studies showing diesel exhausts possess "significant mutagenic properties" which cause genetic changes in bacteria.

The test procedure used in the initial study of the mutated bacteria has in past cases been shown to be 85 percent to 95 percent accurate in detecting substances which can cause cancer, the agency said in a memo to other government agencies.

"Substantial research is either now under way or being planned, to obtain more information on diesel-exhaust particulate emissions from both light and heavy duty vehicles," the memo added.

Agency officials said they expect some results from the research program within six to nine months and that new results would allow the agency to reach additional conclusions on the potential danger to persons exposed to diesel exhaust fumes.

Barth said the preliminary research has not provided enough information to "support the conclusion that there is any present danger from driving diesel vehicles or from having them on the road."

But the agency said people should not eat or drink in an area where they are exposed to diesel exhausts and urged those who work around concentrated exhaust fumes to wear protective clothing.

It also said "diesel engines should not be allowed to idle unnecessarily in enclosed unventilated spaces without the exhaust being vented..."

VOCABULARY

1. A colorless, odorless, poisonous gas given off by burning fuels (e.g., trucks, autos, etc.) - - - - - - - - - - - - - - - - -

2. A chemical often found in factory smoke which is harmful to lungs - may cause cancer - - - - - - - - - - - -

3. A chemical element that makes up 78% of the air - - - - - - - - -

4. A gas that makes up 21% of the air - - - - - - -

5. A material that pollutes the air, water or soil of the earth - - - - - - - - - -

6. One of the poisonous gases that pollute the air (factories and coal burning a big factor) - - - - - - - - - - - - - - -

7. Weather condition in which a layer of warmer air lies above a layer of colder air, holding smoke and gases to earth - - - - - - - - - - - - - - - -

Pollution Vocabulary

		C	A	R	B	O	N	M	O	N	O	X	I	D	E			P
●	S	P															O	
			H				N	E	G	O	R	T	I	N			L	P
				O												L		A
N					T										U			R
D	O			H		O								T				T
I		I		Y			C						A					I
T			S	D				H				N		A	P	E		C
S				R					E		T							U
U				O	E					M								L
B				C		V					I							A
M				A			N					C						T
O				R				I					A					E
C				B					E					L				M
L				O						R					S			A
A				N							U					M		T
N												T					O	T
R													A				G	E
E			O	Z	O	N	E							R		N		R
T															E			
N														G		P		
I													Y				M	P	P
●												X						E	
			M	U	R	C					O								T

Pollution Vocabulary

H	L	C	A	R	B	O	N	M	O	N	O	X	I	D	E	I	N	J	P
[redacted]	S	P	I	E	Q	J	U	T	G	L	S	N	R	K	F	J	P	O	K
M	H	D	H	R	I	V	N	E	G	O	R	T	I	N	H	K	L	Q	P
O	C	X	P	O	W	D	T	G	C	S	B	H	R	I	Q	L	H	R	A
N	W	S	X	Y	T	M	C	U	I	P	J	V	E	L	U	P	M	L	R
O	O	M	A	H	E	O	T	O	J	I	K	H	N	T	F	K	J	I	T
I	G	I	C	Y	N	D	C	P	M	W	J	V	A	G	W	G	O	J	I
T	B	N	S	D	F	S	Q	H	C	V	U	N	M	A	P	E	Q	L	C
S	V	T	U	R	O	K	X	L	E	B	T	L	T	I	U	X	H	M	U
U	F	O	D	O	E	Y	K	D	M	M	L	U	Z	K	S	F	N	K	L
B	A	B	V	C	R	V	W	B	N	R	I	A	F	Y	J	Y	I	G	A
[redacted]	Y	U	E	A	H	Z	N	E	C	D	V	C	E	G	T	E	M	N	T
O	E	C	W	R	G	L	O	I	N	T	W	S	A	H	H	K	L	K	E
C	A	O	F	B	Q	A	Y	O	E	K	X	J	I	L	I	J	P	F	M
L	U	V	X	O	F	M	F	P	L	R	M	T	Q	Q	S	D	J	O	A
A	Y	D	G	N	O	B	X	S	Z	N	U	O	H	R	K	M	E	L	T
N	D	W	Y	Z	E	P	A	Q	G	P	R	T	G	L	C	J	O	M	T
R	X	E	H	X	Y	Z	N	C	A	B	D	U	A	S	Z	W	I	G	E
E	G	T	O	Z	O	N	E	P	E	Q	F	R	M	R	D	N	H	P	R
T	W	F	I	W	D	Y	A	X	T	W	B	U	V	A	E	V	G	N	S
N	B	Y	A	Q	Z	C	P	B	S	O	[illegible]	N	R	G	J	P	O	Q	C
I	C	A	G	R	S	U	X	K	T	Y	A	B	Y	P	I	F	M	P	P
[redacted]	W	Y	C	B	H	L	Q	M	A	D	N	X	O	E	C	P	R	E	B
E	F	V	M	U	R	C	V	S	X	U	C	A	B	T	Q	S	U	T	T

Grade Level: 7-12

Title: Environmental Simulation Problem

Objective(s):

To make students aware of a typical environmental problem and to develop an understanding of logical processes in reaching a solution.

Materials:

copies of handout

Procedures:

As a part of an environmental study on clean air, have the students read the following simulation. After students have read the simulation, the teacher should select one or more of the class activities and conduct them with the class.

Class Activities and Questions:

The story you have just read is a simulation of a realistic problem which can, and often does, confront local communities. Some of the activities which could accompany this lesson are:

1. Discussion Questions:

   a. If you lived in the community described in the story, what would be your attitude regarding the vinegar odor? What would be the attitude of a resident of the city who lived two miles away?

   b. Was Jim Strider out of line as a teenager to attempt to change the long standing practices of manufacturers?

   c. Does one person or group of people have the right to pollute other people's environment?

2. Role Playing:

   a. Have students assume the roles of officials representing the A and J Food Company, and debate the issues with other students representing neighborhood residents.

3. Field Trips:

   a. Have students visit an EPA Air Control facility so that they might learn of the monitoring, investigating and enforcement activities conducted by this agency.

Submitted by: James Potter

PROBLEM

Jim Strider jumped out of the interurban bus onto Union Street and walked toward his new school--Alternative High. Jim, his parents and school counselor had decided, last June, that his style of learning might be better suited to a more open environment than the traditional school setting. Thus, he found himself on this particular Wednesday in late September approaching Alternative High with a feeling of anticipation he had not known for a long time.

As Jim hurried toward the old ramshackle building which housed Alternative High, his nostrils were greeted by the unmistakable, and very strong, odor of vinegar. He thought this very strange that the whole neighborhood would smell of vinegar and decided to ask Mr. Melcher, his Current Topics teacher during today's fourth hour class.

Mr. Melcher had taught at the high school for five years and was aware that about every two weeks the odor of vinegar was present in the school neighborhood, for a period of about two days. He thought that the release of the fumes must have something to do with the manufacture of vinegar, but was not overly upset by their presence.

Jim was insensed. He did not believe that the whole neighborhood could calmly sit back and allow the vinegar manufacturer to smell up their environment without some kind of protest. Jim's protestations convinced two of his classmates that something ought to be done. For starters, they decided to arrange a meeting with the plant manager who, as it turned up, was also the company president. After being put off for nearly a week by a super efficient secretary, the delegation finally arranged a meeting with Mr. Alcocer, the company president.

In the meeting with Mr. Alcocer, Jim and the other students pointed out that the vinegar fumes were polluting the neighborhood environment and that no one had the right to do this. Mr. Alcocer, in defense of his company, told the students that the fumes were not toxic and posed no problem to people or vegetation, or in any other way were harmful in any real way. Further, he indicated that to change his manufacturing process would require a large amount of money, an expense which he did not feel the company could afford. Finally, he said that apparently the neighbors were not upset by the vinegar, because in the fifteen years his company had operated in the area, he had not received a single complaint.

When Jim and his two friends reported to their classmates Mr. Alcocer's point of view regarding the vinegar fumes, student support of the project was gained very quickly. Mr. Melcher, while reticent about leading the project, was obviously sympathetic to the cause and was willing to spend class time to discuss strategy and make plans. One of the first considerations had to do with where the power is vested to force a change in the company's policy. It was decided that the mayor of the city could exert that force, if he and the city council could be convinced. It was reasoned that as elected officials, the council and mayor would respond favorably if they heard from the local citizens on the matter. It was decided that a petition circulated in the neighborhood would have the desired impact upon the city fathers. One student's

father was an attorney and prepared a petition which called for the elimination of the practice of releasing noxious and annoying odors by the A and J Food Company. With Mr. Melcher's assistance, the students mapped out a five square block area which would be the target of the petition drive. A two week period was established as the length of the petition drive, and student teams took to the streets to obtain as many signatures as possible. The students were well coached by Mr. Melcher and presented themselves very well as they approached the residents of the neighborhood. The drive was an instant success. Most residents quickly signed and indicated that they had been annoyed by the fumes but didn't think anything could be done. The student action began to attract the attention of the media, and Jim acting as spokesman, was interviewed by the two city newspapers and appeared on local television to explain the student cause.

At the end of the two week period, approximately 80% of the residents of the target area had signed the petition. A letter was drafted and sent to the mayor of the city requesting a meeting for the purpose of presenting the petitions. The meeting date was established and Jim and three other members of the group met with Mayor Phillips in his offices. The mayor was most impressed with the students' work and agreed to take the petitions to the council.

On the night of the council meeting Mayor Phillips discussed with the council the petitions and the alleged air pollution on the part of A and J Food Company. The council was advised that the city had an ordinance which prevented the pollution of the atmosphere by the release of noxious fumes. The ordinance was originally designed to deal with the problems posed by heavy industry, but nevertheless in the opinion of the city attorney, applied in this case.

Mr. Alcocer was formally notified that the A and J Food Company had six months to comply with the ordinance, or cease its operation in the city. The company, through some changes in its manufacturing process, was able to comply with the ordinance in four months.

Grade Level: 9-12

Title: Pyrolysis Demonstration

Objective(s):

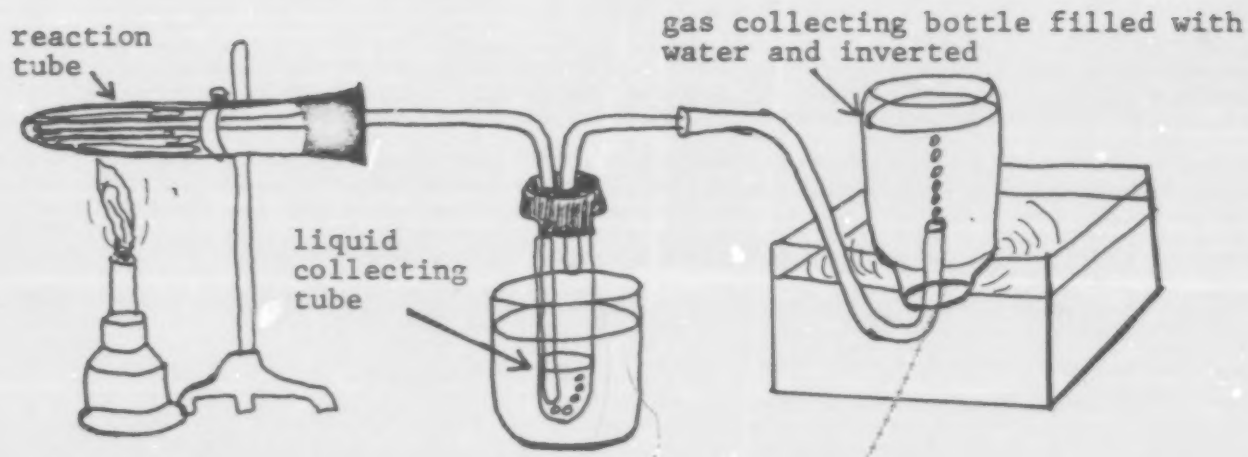
To discover the products of burning in the presence of insufficient oxygen.

Materials: (per group of 4-5 students)

20 wood splints (or try wood shavings or coal)
2 alcohol burners (or bunsen burner)
1 ring stand
1 test tube clamp
2 right angle glass tubes
2 test tubes
1 beaker
1 gas collecting bottle
1 pan
1 rubber hose

Procedures:

1. Set up the apparatus using wood splints packed tightly as shown in the figure in the reaction tube.



2. Light the burner, moving it slowly under the material to be burned.

3. Allow a few bubbles of gas (air from the liquid collecting tube) to escape through the rubber tubing prior to inserting the tube into the gas collecting bottle.

4. After collecting a 1/2 bottle of gas remove the rubber tubing, slide a glass plate under the mouth of the bottle, life the bottle out of the water and set it right side up on the desk still covered with the glass plate.

5. After disconnecting the rubber tubing from the glass tubing, try to light the gas escaping from the end of the glass tube. (If burns, gas may be CO or H_2S)

6. Quickly pour 5 ml of limewater into the bottle, replace glass plate and shake the bottle. A white precipitate indicates the presence of CO_2 in the bottle.

7. Observe the liquid in the collecting tube. Pour the liquid into an evaporating dish and set it on an asbestos mat. Try to light the liquid. (Liquid may contain alcohol, formaldehyde or other organic compounds)

Questions: (during or after demonstration)

1. Is water vapor given off?

2. Does the fuel glow?

3. Is CO_2 given off?

4. Is there smoke?

5. Does the smoke smell?

6. How do the products differ from those of burning in sufficient oxygen?

Bibliography:

adapted from: Investigating Our Environment, Greisel & Jensch, Boston: Houghton Mifflin, 1976. pp. 88-91

Submitted by: Aldona Petrauskas

Grade Level: 7-12

Title: Air Pollution Comics

Objective(s):

To allow groups of students, through their own research and creativity, to develop comics that will illustrate:

1. That air pollution is wide-spread and comes from many sources.

2. That air pollution seriously affects the quality of our lives.

3. That problems concerning air pollution must be recognized and solutions must be implemented.

Materials:

sufficient copies of the reference materials listed in the bibliography (ten copies of each booklet, minimum)
art supplies (large sheets of paper, markers, etc.) or
overhead transparencies or spirit masters (one per group)

Procedures:

Students will compile a FACT SHEET based on information obtained from reference sources. This material should be accurate and should include:

1. sources of air pollution
2. types of air pollution (gaseous and/or particulate)
3. effects of various pollutants (health, economic, aesthetic)
4. laws and/or procedures limiting amounts of pollutants
5. definition of terms

Using this information, each group will design a COMIC STRIP to teach the facts. The objectives stated earlier should be met by each group within the comic strip.

Discussion:

Students will be able to answer the following questions after viewing projects:

1. What causes pollution in your community?
2. Is air pollution visible?
3. What chemicals (gases, aerosols, solids) cause pollution?
4. How is man affected by pollution? What about vegetation, buildings, nylon, rubber, metals, crops, livestock?
5. What laws have been passed in your area concerning the burning of leaves, use of pollution control devices, incinerators, etc.
6. What are some of the invisible sources of air pollution?
7. What can we do about pollution?

Bibliography: (include others if possible)

"Environmental Action--No Time to Waste", Richard Hatch Associates, 1971, Continental Can Company.

"Environmental Quality: Key to a Better World", 1971, Consumers Power Company.

"Needed: Clean Air--The Facts About Air Pollution", 1974 edition, Channing L. Bete Co., Inc.

Submitted by: Liz Rashid

FACT SHEET--AIR POLLUTION (Sample)

NOTE: The students should be encourage to compile their own fact sheets using available resources. The facts can be verified and/or clarified before the comic strip is designed. All facts used in the comic should be accurate, since these comics will be used to teach air pollution concepts.

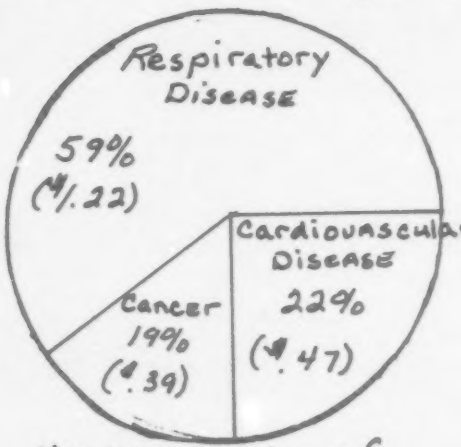
From - "Needed - Clean Air" (pp. 4-5)

Carbon Monoxide (CO) - dizziness ——> death
common in tunnels, heavy traffic
esp. dangerous to people with asthma, anemia, heart disease

Sulphur Dioxide (SO_2) - effects lungs, muscous membranes
harmful to plants, metals
decreases visibility
produced primarily by factories

Hydrocarbons - produced in car exhaust
combine with O_2 ——> smog
causes cancer in animals

From "Damages From Pollution" (p. 18) The Price of Progress



Health Costs of Air Pollution
(in billions of dollars)

This cost amounts to approximately $80 per person annually.

From "Air Pollution Primer"
Documented effects of air pollution:

(Meuse 1950) Accident at Sulfur-producing factory spread S compounds over area. 22 dead, 320 hospitalize

(New York 1966) 3 day inversion over area - 168 dead

London 1952) 5 day inversion Smog caused 4000 deaths

(pp. 60-61)

ODOR-O-NO

ONE MORNING, OVER THE TOWN OF OLEUM, A hideous, REPUGNANT cloud LURKED.

SOON, THE TOWNSFOLK BEGAN TO SWOON. THE WARNING bell, high IN A TOWER, BEGAN TO CLANG.

"PING-, PING-"

BUT THE bell WAS SO CORRODED by THE Cloud of PARTICULATE PERIL, THAT iT "Pinged" WHEN iT should have "Dinged" AND THE PEOPLE couldn't HEAR iT.

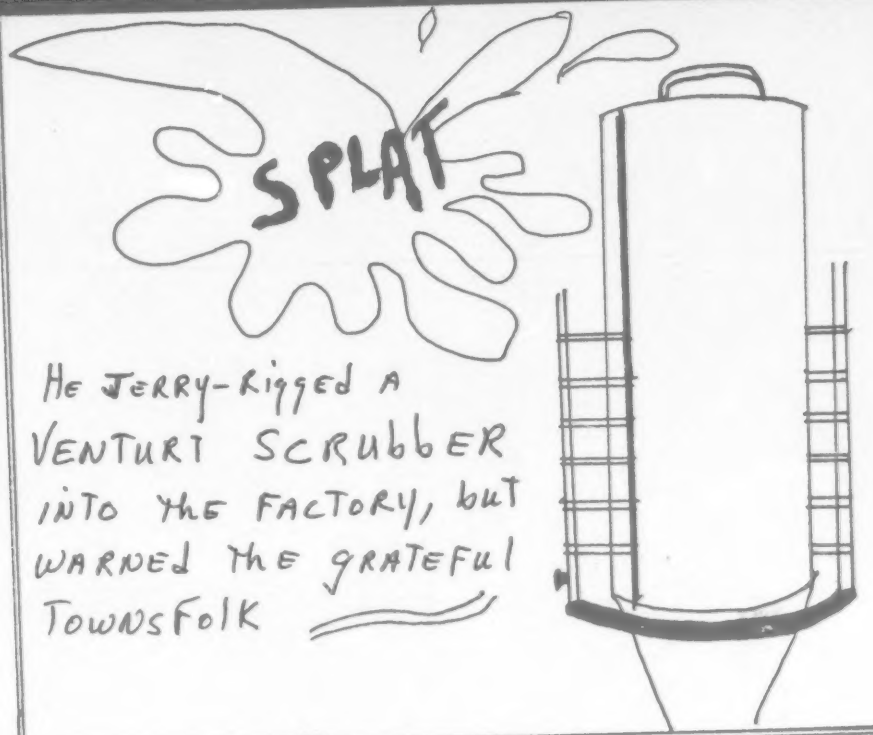
THE SCANDALOUS SITUATION CALLED FOR

ODOR-O-NO

who WAS AROUSED FROM SLUMBER by THE STINK AND THE "PINGS".

Air Pollution Comics
Page 4

QUICKER THAN A NEUTRON BULLET, ODOR-O-NO FOUND THE CAUSE OF THE CLOUD— AN OLD FACTORY, OWNED by P.U. BELCHER, WAS SPEWING SO_2 OVER THE AREA.



HE JERRY-RIGGED A VENTURI SCRUBBER INTO THE FACTORY, but WARNED THE GRATEFUL TOWNSFOLK

UNLESS YOU TAKE ACTION THROUGH THE COURT, P.U. BELCHER will LAUGH AND SNORT

94

POLLUTION will GROW DAY BY DAY AND BILLIONS of DOLLARS YOU will PAY!!

THE END

95

Grade Level: 7-12

Title: Investigating Air Pollution

Objective(s):

At the completion of a successful encounter, the student should be able to:

1. Identify an air pollution problem within the local area.
2. Identify the importance of firm or factory causing pollution to the area.
3. Define the major types of air pollution.
4. List (number) effects of air pollution on living organisms.
5. List some of the laws which have been recently passed in an effort to control air pollution.
6. Identify the law enforcement agencies that enforce these laws.

Materials:

paper plates
vaseline
terrarium
flask
light bulb

Procedures:

Find a plant, factory or shop in the area that is emitting some type of air pollution.

Questions:

1. What is the function of the plant? What is their product? What are the processes used to produce that product?
2. Classify the type of air pollution. Is it a result of particle, emissions, gas emissions, or both?
3. To get an idea of how much pollution is given off in a way of particular matter perform this simple experiment: Get (number) large plates. Cover one side of the plates with a greasy or sticky substance such as vaseline. Set one of these plates near the point of pollution with another plate a little further away and so on. Come back after a period of time (depending on the amount of pollution) and observe the particulates that have settled on the plates.
4. What effect do you think these particulates would have on living organism?

5. Considering the production process used by the plant, what types of chemical gases might also be given off as a source of air pollution? What effect do you think these gases have on the surrounding environment?

6. Set up terrariums in the back of the room. Place an open beaker which has been filled with the same chemical that is used in the factory in the terrarium. Place a couple of light bulbs against the sides of the terrarium. This will provide a source of light for the plants and will also raise the temperature in the terrarium which will speed up evaporation of the chemical. Make sure the top of the terrarium is covered, you may want to vaporize the chemical in a flask and pipe the chemical vapor in to the terrarium. If you suspect two or more chemical are given off by the factory you can test the others in the same way or you may want to combine a couple of the vapors to find out if this has a different effect on the plants.

7. What effect, if any, did the vapors seem to have on the plants?

8. Do you think some types of pollution control should be placed on that factory or shop? Which type of political structures would handle this? How could you bring it to their attention?

9. Develop a plan of action and execute it.

Bibliography:

Environmental Education Activities Manual by William B. Stapp and Dorothy A. Cox. Junior High Activities

Submitted by: Cheryll Greene

Grade Level: 7-9

Title: Air and Air Pollution

Objective(s):

1. To recognize that we live in an ocean of air.
2. To discover that air is real, fills things, occupies space and has weight.
3. To become aware that air can become polluted because of people and their life style.
4. To realize that air pollution can be harmful to living things.

Materials:

plastic bag
water tumbler
soil
piece of building brick
paper napkin
ruler
yard stick
string
balloons
graph paper

Procedures:

Part A - Air is Real

1. The teacher will introduce the lesson on air.
   a. Air is all around us.
   b. We life at the bottom of an ocean of air.
   c. Air occupies the space all around the earth to a height of hundreds of miles.
2. Air is a mixture of many gases. The two principal gases in the air are oxygen and nitrogen.
3. Demonstrate how air is present by capturing it in a plastic bag, squeeze it, and sense its resistance to being pushed aside.
4. Demonstrate how air is present in soil. Put some loose soil in a water tumbler until the tumbler is half-full. Pour water in the tumbler until the tumbler is almost full. Bubbles of air will escape from the soil, showing the presence of air.
5. Air is present in water. Fill a glass tumbler with cold water, and then set the tumbler aside for a few hours. Tiny bubbles of air will appear on the sides of the glass. Air is dissolved in the cold water. Then when the water becomes warmer, it cannot hold as much air so some of the dissolved air comes out of the water and forms bubbles on the side of the glass.
6. Demonstrate how air is present in porous material. Drop a piece of building brick into a wide mouthed glass jar that is three quarters full of water. Bubbles of air will escape from the tiny pores in the brick.

7. Demonstrate that air occupies space. Crumple a dry paper napkin and stuff it firmly into a glass tumbler so that it will not fall out. Push the tumbler straight down to the bottom of the large jar. Note the water does not fill the tumbler. The space is occupied by air. When you lift the tumbler out, note the napkin is dry.

8. Air has weight. Place a pile of books at the edge of a table. Insert a flat stick about 12 inches long between the books and the table top. Tie one end of a string about 12 inches long to the flat stick, and tie the other end of the string around the middle of a yardstick. Obtain two large balloons of the same size. Slide the balloons back and forth along the yardstick until it balances evenly. Puncture one of the balloons. The deflated balloon will not weigh as much as the balloon that still has air in it.

(NOTE: Students will help to demonstrate all of the above experiments.)

9. Feedback: Students will conduct an experiment of their own to show the presence of air.

Part B - Air Pollution

VOCABULARY:
carbon monoxide
lead
poisonous
air pollutant
incinerator
agricultural burning
respiratory diseases
emphysema
asthma
bronchitis
lung cancer
smog
statistics

1. The teacher will introduce the following information:

   a. Air is man's most important natural resource. Man can live without food for weeks and without water for days, but he can life only minutes without air. Since air is necessary to life, man should be careful about what he does to it.

   b. Air often becomes polluted because of man's efforts to improve his life. The main source of pollution is (1) motor vehicles, (2) burning of fuel, (3) industrial burning, and (4) waste disposal.

   c. Motor vehicles are the biggest cause of air pollution. More than half of the poisons in the air are put there by motor vehicles. They pour millions of tons of carbon monoxide out into the air each year. Carbon monoxide is a colorless, odorless gas which can kill a person by stopping oxygen as it moves from the lungs to the rest of the body.

   d. Burning fuel is the second largest cause of air pollution. More than 80% of the electricity used by the United States is produced by burning coal and oil.

e. Industry is another major cause of dirty air. As they make their products, industries such as paper mills, steel mills, and oil refineries fill the air with chemicals and pieces of dirt. They put millions of tons of pollutants into the air.

f. In the U.S. millions of tons of solid wastes are produced every year. Because burning wastes does not cost too much or take up much space, it is often the way used to dispose of garbage.

g. Two other causes of air pollution are agricultural burning and forest fires. For example, agricultural burning is common in places such as Hawaii. When the sugar cane is ready to be cut, farm workers go through the fields with torches and burn the leaves. Destroying the leaves makes it easier to cut the cane, but it also adds pollutants to the air.

h. Air pollution is harmful in many ways. It damages men's health, agriculture, the economy, and the quality of life.

2. After the lesson on Air Pollution, the students might draw pictures or cartoons expressing how they felt about air pollution.

3. Graphs could be used to show facts and to give a clearer picture of a problem. For example, students could make a bar graph to show that 61 out of every 100 parts of air pollution come from cars and trucks, 17 parts come from factories, 12 parts come from electric plants, 7 parts come from furnaces, and 3 parts come from burning wastes.

Questions: (concerning a graph)

1. Where does most air pollution come from?

2. Cars and trucks together with factories make how much air pollution?

3. Electric plants make less air pollution than _____?

4. Furnaces and burning wastes together make (less/more) air pollution than factories.

5. What are some things that people can do to decrease air pollution?

Bibliography:

The World of Mankind: The Environment We Live In. Chicago: Follett Publishing Co., 1975.

Submitted by: Mary LeBlanc and Helen Trahey

Grade Level: 7-12

Title: Pollution Experiments

Objective(s):

The student will, by the means of simple experiments, isolate pollutants and use data for comparison purposes.

Experiment 1: Study of Air Pollution

To collect particles from the air.

Materials:

file cards, 7 cm x 13 cm (four)
masking tape
dowel sticks 30 cm long (four)
magnifying glass (reading class)

Procedures:

Use four cards about 7 cm x 13 cm. Put two strips of masking tape - sticky side out - the length of each card. Fasten on the backs. Mount each card on a dowel stick about 30 cm long with tape or tacks. Place one card on each side of the school building (or home) with the sticky side facing the wind. Mark the location on each card (north, east, south or west). Leave the card in place for three days, then bring them into the classroom. Compare the cards for the type of material collected on each one.

What sort of material did the cards collect? Did it make any difference which side of the building the cards were? Do you think this material would be classed as "smog"? Was any of the material produced by humans? Is there any way this material could be reduced?

Experiment 2: Study of Car Exhaust

To collect hydrocarbons.

Materials:

car
absorbent cotton, small box

Procedures:

Hold a piece of absorbent cotton over the exhaust of a car, with the motor running, for about five seconds. This could be done at home or at school on any car available. (Use caution around the air.) Examine the cotton.

Compare the deposit with the material collected on the sticky cards.

Which material has a distinct odor? Which one has a sticky feel? Could you see either material while it was in the air? Which deposit

is caused by the nature? Which by machinery? Is either deposit harmful to humans? Why? Could either kind be controlled?

Experiment 3: POLLUTANT (CO_2)

To learn the effect of CO_2 on plants.

Materials:

green plant six inches tall (two)
gallon size plastic bags (two)
car
lift pump
plastic hoses (several feet)
hose clamp (two)

Procedures:

Obtain two young green plants, about six inches high. Place each plant in a one-gallon size clear plastic bag around a rubber or plastic tube. Water both plants regularly and keep them in the sunlight. Attach a double-action hand pump to the tube so that air can be pumped into the bags. Once a day, use the exhaust pipe of an automobile with the engine running as a source of clean gases. Pump these into the bag surrounding the experimental plant and clamp the tube shut so that the gases do not escape. (Caution: Do this outside and avoid breathing the exhaust gases as much as possible.) At the same time, pump a similar amount of air without exhaust gases in the bag surround the control plant. Keep the inlet tubes clamped shut for several hours after the gases are pumped into each bag. After several days, compare the color and texture of the leaves on both plants.

What are the differences you observed in the growth of the two plants? Why?

Experiment 4: Air Pollution

To study the particulate matter in the air.

Materials:

filter paper (one)
tank-type vacuum cleaner
magnifying glass

Procedures:

Place a piece of filter paper over the end of the hose of a tank-type vacuum cleaner. Turn on the switch and allow the motor to run for several minutes while holding the hose in mid-air. Stop the motor, examine the filter with a lens under a bright light, and compare it with an unused piece of filter paper. Explain any difference noted. Repeat the test indoors and outdoors several times at different hours and on different days.

Experiment 5: Air Pollution

To observe volatile liquids.

Materials:

four small bowls
a graduate cylinder
thirty milliliters of kerosene and spirit duplicator fluid

Procedures:

Pour thirty milliliters of each liquid into a separate bowl. (Caution: do this only in a well ventilated room near no open flames.) Try to place the bowls in a warm sunny spot about eighteen inches apart. Carefully sniff the air about eight inches, then twelve inches above each bowl.

What do you smell? Now look carefully at the air over the bowls in the direction of the sunlight. Do you observe anything? After about thirty minutes, what is left in each bowl? Explain what you have observed? Where did the liquids go? Is the air more polluted or less polluted from what took place?

Bibliography:

Modern Science, Forces, Change and the Universe by Blanc Fishler and Gardner.

It's Our Choice by V. Knight Jr., and J. Moore.

Focus on Earth Science by Bishop, Lewis, and Sutherland.

Modern Physical Science by Tracy, Thopp and Friedl.

Submitted by: Creola Powell, Bernice James, and Fred Thomas

Grade Level: 7-12

Title: Sniff and Read

Objective(s):

Given ziploc bags of scented cotton balls the learner will sniff the cotton ball and identify the smell.

Materials:

1. Scents that approximate the odor of the pollutants are best. If these are not available, lip gloss scents, concentrated candy flavoring oil, scratch and sniff cards, or other strongly scented materials may be used.

2. The scented letters can be consecutively numbered to do away with the unscrambling, or the pollutants may be listed on the chalkboard to help students unscramble the letters that spell out their pollutant.

3. Extra unscented letters, not used in spelling out the pollutants, can also be placed in the letter bag.

SAMPLE CARD:

(Sample Pollutant Description Card for Student)

This pollutant is caused by a reaction between the sun's radiant energy and the compounds of nitrogen, sulfur, and hydrocarbons in the air. It can be very harmful to life. In London, it caused over 4,000 deaths. Those who died were mainly older people who had lung and heart problems.

You can find this pollutant by smelling this card and matching its odor with the scented letters in the bag. When you have identified all of the letters, unscramble them to find this pollutant.

Letters whose scent matches the scent on this card will spell "SMOG".

SAMPLE CARDS:

(Sample Pollutant Description Card for Student)

> This element enters the air from the burning of fuel, trash, etc. When it combines with oxygen in the air, it forms compounds which damage paint, rubber, and nylon. It causes our eyes to burn and is dangerous to people who have breathing problems. When its compounds combine with water vapor in air, acids are formed which cause damage to cars, clothing, plants, and people.
>
> You can find this element by smelling this card and matching its odor with the scented letters in the bag. When you have identified all of the letters, unscramble them to find this element.

Letters whose scent matches the scent on this card will spell "SULFUR".

Other pollutants that may be described on cards:

Nitrous Oxide - (NO)

Hydrogen Sulfide - (HS)

Ozone - (O_3)

Procedures:

Each group of four students will receive four 3 x 5 cards, each containing a description of an air pollutant and a characteristics odor that represents the pollutant. The group will also receive individual bags which contains scented letters that match the odors on the 3 x 5 cards. The students will smell out the letters that have the same odor as their 3 x 5 card and then unscramble the letters to identify the pollutant.

Submitted by: Daniel Oden

Grade Level: 7-12

Title: Investigating Air Temperature Changes

Objective(s):

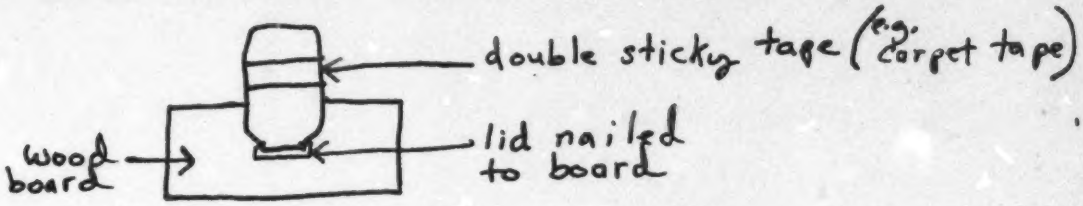
1. To find out how the air temperature changes:

   a. as you go up a hill (or building)

   b. as you stand on the north side or the south side of a hill (or building).

2. To find out how the wind factor changes from the bottom to the top of the hill (or building) and how it affects the plant growth.

3. To check the amount of pollution by putting several jars with double sticky tape at each temperature and location.



4. To find some practical applications from the data.

Materials:

compass
thermometers
modified Beaufort Wind Scale Chart
jars
double stick tape (sticky on both sides)

Procedures:

Modified Beaufort Wind Scale Chart

	What to look for:	Wind Speed in MPH:
1.	Smoke rises vertically.	Less than one MPH
2.	Smoke, but not wind vanes, shows wind direction.	One to three MPH
3.	Wind felt on face; leaves rustle; wind vane moves.	Four to seven MPH
4.	Leaves and small twigs moving constantly; small flags extended.	Eight to twelve MPH
5.	Dust and loose paper raised; small branches moving.	Thirteen to eighteen MPH

6.	Small leafy trees swaying.	Nineteenth to twenty-four MPH
7.	Large branches moving; whistling heard in telephone wires.	Twenty-five to thirty-one MPH
8.	Whole trees in motion.	Thirty-two to thirty-eight MPH

Divide the class in groups of about six students. Each group can take a section of the hill (or building). Example: north top, north bottom, south top, or south bottom. Then rotate the groups. Obtain the following information:

	NORTH SIDE		SOUTH SIDE	
	TOP	BOTTOM	TOP	BOTTOM
Wind direction				
Wind speed				
Air temperature on ground				
3 ft above ground				
6 ft above ground				
Amount of pollution shown on double sticky tape				

Questions:

What are some of the practical applications of this data? (Make up your own questions, ... here are some examples.)

1. If you were building a house, would you build it on the top, middle, or bottom of the hill? Why?

2. Would you build it on the North or South side? Why?

3. If you were going to plant a garder or flowers, where would you plant them? Why?

4. Where is the most air pollution? What are some of the possible reasons for this?

Grade Level:

Title: 5. How will the air temperature combined with the wind factor affect your fuel bills?

Objectives:

Submitted by: Barbara Dempster

Materials:

Introduction:

Grade Level: 7-12

Title: Particulates in the Air

Objective(s):

1. To teach students to collect pollutants.

2. To aid students to "see" pollution and to be able to comment on them.

Materials:

air filter
vaseline
vacuum cleaner with hose
graph paper

Procedures:

This exercise will help you "see" air pollution. "Big deal", you may say. Who hasn't seen air pollution today? A ride through any big city during the week will give you that "thrill".

But that isn't quite true. Of course, it doesn't take any special scientific training to realize the smell and appearance of polluted air. But once you've said that the air "is polluted", what else can you say about the pollution just by looking at it? Probably not much. This exercise will give you a way of making some very specific comments about the amounts and kinds of one general class of pollution in the air: the particulates.

Particulates are tiny pieces of dust and dirt in the air. You can actually see (and maybe even count) them, something which you cannot do with other pollutants like carbon monoxide and nitrogen oxides, which are invisible gases. The idea is to get these visible particles of dust and dirt to settle down on a white surface where you can see them clearly. There are two ways of doing this:

1. Find a clean piece of filter paper (your teacher is the source) and fit it over the hose of an electric vacuum cleaner. Hold the paper in place with a rubber band around the mouth of the hose. When you turn the vacuum cleaner on, air will be drawn in through the hose and through the filter paper. Most particulates that are in the air will be trapped on the filter paper where you can see, and perhaps count them. You should let the vacuum cleaner run for a fair length of time (fifteen to thirty minutes) in order to capture enough particles to see and count. Do the experiment first of all in a place where there is likely to be almost no pollution at all. This gives you a basis for comparing your results from other, more polluted places. Report your results as suggested below.

2. Capture particulates in the air by getting them to land on and stick to a thin layer of very clearn vasaline which has been spread across the surface of a "test block". The test

block might be a white square of porcelain or painted wood, or any other material which will not soak up the vasaline, but which will be bright enough for you to see particles against. Make one test block for each area in the environment you want to test (for example, one each for the front steps of your house, for the roof, for a place near the Niftee Candy Factory, for a place near the railroad station, and for a place near the hospital). Leave your test block out in the open in each area for twenty-four hours. When you collect the blocks again, take them back to school and see what you have collected. (For more details on this method, see Wentworth, Couchman, MacBean and Stecher, Pollution, Holt, Rinehart & Winston, 1971, pp. 26-31.)

For your report, prepare a graph which shows what kind of particles you found on your test surface (pieces of dirt, dust, seeds, sand, animal droppings, grass, etc.), and how many of each you were able to count. What did you find most of in your own research for each area?

Submitted by: Edwin Thomas

CAPSULE IDEAS ON AIR QUALITY

Demonstrate air is present. Capture air in plastic bag, squeeze it, and sense its resistance to being pushed aside.

Adapted from: World of Mankind, Follett Text
Submitted by: Helen Trahey

Noise pollutes air. In a quiet place, write down all noises you hear. Realize that you get so used to noises you sometimes fail to realize that it takes energy to listen, and noise can make you tired and irritable.

Adapted from: Save the Earth, by Betty Miles
Submitted by: Cheryll Greene

Contribution of nicotine towards air pollution. Have "smokers" blow puffs of smoke into a terrarium; also add piece of paper with identifying code. After a few days, observe residue of both glass and paper.

Submitted by: Vince DeSanto and Monica Schultz

Role-playing-anti-air pollution. Committee versus industry and big business.

Adapted from: Nature of Cancer, Resource Kit
Submitted by: Linda Gagnon and Pat Burnell

Poster Activity. Draw posters depicting areas polluted by air. After presentation, allow time for creative writing concerning causes and solutions.

Submitted by: Margaret Raglin and Terri Merritt

Telephone your local branch of the Environmental Protection Agency. Ask what are the common local pollutants. Report on them, determining what harm each does.

Submitted by: Dean Lande

What would happen if all air pollution was stopped by order of the President? Tell effect on factories, jobs, families, education, and businesses.

Submitted by: Vitalija Keblys

Collect air particles for comparison of pollutants. Put masking tape - sticky side out on cards. Leave cards in various places for three days. Collect, examine under microscope and compare.

Submitted by: Creola Powell, Bernice James and Fred Thomas

TV Commercial. Communicate the need to inform the public of air pollution in a one-to-three minute commercial.

Submitted by: Julie A. McDonnell

Decide how activities of people contribute to disease, etc. Accumulate a (1) pollutant, (2) major source of same, and (3) effect list. Example: (1) Hydrocarbons, (2) Automobiles, and (3) Part of smog - can cause cancer.

Submitted by: J. Randall Mikula

Letter writing activity. Take a stand on current air pollution problem. Write a letter as a concerned citizen to the Environmental Protection Agency and ask for action.

Submitted by: Mary LeBlanc

ENERGY

Energy Awareness

Grade Level: 7-12

Title: Energy Awareness

Objective(s):

1. To stimulate the minds of the students into a personal evaluation of their attitudes on energy conservation.
2. To question the students on the awareness of energy in their lives and how they, in their lifestyles, use energy.
3. To make the students aware of increased consumption of resources as demand and production of goods increases.
4. To make the students aware of the many and varied ways of transforming energy from one form to another.
5. To encourage the students to, with an open mind, seek energy alternatives and ways of conserving energy in their lives.

Procedures:

1. List 13 electrical appliances you use at home (lights, TV, radio, etc.).
2. Now cross out 3 things you can do without.
3. Now check 3 things you feel that you couldn't do without.
4. Next, circle the items which you've obtained within the last 5 years (3 things which would not have been on your list 5 years ago).
5. Share your list and reasons with the class.

   a. Identifying one's priorities is necessary when considering among various alternatives.

   b. Many electrical appliances are luxury items, which are seldom used, and are not very important to one's life style. Perhaps these items might not be purchased if a person thought about whether the item was very important, or just another thing to buy.

   c. The U.S. has doubled its energy consumption in the last 20 or so years. With only 6% of the world's population, the U.S. Consumes some 37% of all the energy used in the world. A large portion of this increased energy consumption is due directly to the purchase (it takes energy to produce an electrical appliance, as well as energy to use it) and use of non-essential or luxury appliances.

   d. Identifying those items obtained within the past 5 years indicates personal trends in purchasing and consuming behaviors.

e. Looking at the items crossed out as non-essential, you can begin to think how easy it is to stop using those items once they have been identified.

From the following list of items indicate your preference by circling the letter of your selection.

1.	regular toothbrush	-OR-	1. electric toothbrush
2.	regular comb		2. electric comb
3.	towel dried hair		3. electric hair-dryer
4.	safety razor		4. electric razor
5.	regular shaving cream		5. heated shaving cream dispenser
6.	regular electric fan		6. air conditioner
7.	hand washed dishes		7. electric dishwasher
8.	hand operated can opener		8. electric can opener
9.	self-defrost refrigerator		9. frost free refrigerator
10.	black and white TV		10. color TV
11.	regular record player		11. deluxe stereo unit
12.	fuel oil heat		12. electric heat
13.	use alternative sources of energy (sun, wind, water)		13. nuclear energy
14.	ride a bicycle		14. drive a car
15.	Volkswagon		15. Ford LTD
16.	drive a car		16. ride a bus or mass transit
17.	take a train		17. fly in a jet
18.	returnable containers		18. non-returnable containers

Discussion questions:

1. How do your choices reflect the typical American life style?

2. Should we limit people's rights to own energy and natural resources using devices like air conditioners, electric heat, electric toothbushes? Why or why not?

3. There will always be a little pollution in order to be prosperous, so why should we concern ourselves about it? Do you agree or not with this statement? Why?

4. The standard of living in the U.S. is the highest in the world. Should we maintain it as such? Why or why not?

5. If you were to be taxed each time you used your electric toothbrush would you pay or protest? Why?

6. Some people argue that we ought to live without all the comforts of life. Do you agree, disagree and why?

7. Should we raise the cost of natural resources and energy so that people will regulate their use?

8. If man continues his present patterns in growth and use of goods, what dangers do you see in the future?

Bibliography:

Glen Erickson. "Baker's Dozen," Environmental Education Activities Manual (Jr. High), ed., Stapp & Cox, 1974, pp. 144-145.

B. Diane Boyd. "You and Energy," Environmental Education Activities Manual (Upper Elem.), ed., Stapp & Cox, 1974, pp. 31-32.

Michael D. O'Farrell. "Study in Demand and Consumption of Natural Resources," Environmental Education Activities Manual (Jr. High), ed., Stapp & Cox, 1974, pp. 53-54.

Mary Lou Hess. "Energy Changes," Environmental Education Activities Manual (Upper Elem.), ed., Stapp & Cox, 1974, pp. 18-20.

Submitted by: Br. Xavier Pankovits

Grade Level: 6-12

Title: Where is the Energy Going?

Objective(s):

To understand the flow of energy in a natural versus a man-made ecosystem.

Materials:

stakes and string
meter sticks
terrestrial insect sweep nets
field guides
any overgrown field in the fall (optional), late spring or summer

Procedures:

Pre-lab discussion of tropic levels, random sampling techniques, what constitutes a reliable sample (1 hour); lab and discussion on food as energy, measuring the calories in different raw nuts using a tin can calorimeter (1 hour); field trip (1 hour); post lab discussion and comparison with urban ecosystem (1 hour). Research birds, snakes known to area.

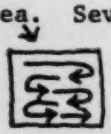
1. Sit down in the weeds to get a bug's-eye-view of things. Get down and look at which plants are being munched on. Who's doing the munching? Notice that not every blade of grass has an insect on it. Look at the surface of the ground. Are there plants that are not producers? What is their function? How are they classified? Look for bird, mouse, meadow vole signs.

2. Look for examples of producers, first order consumers, second order consumers, third order consumers, decomposers, scavengers, and parasites (there are red mites nibbling on daddy long legs' legs, worms in the head and thorax of grasshoppers).

3. Mark off sample area (10' x 10') for insect sweeps and several 1' x 1' plots inside the area for plant counts.

4. Count the number of stalks (all vegetation) per square foot. Take the average for several and estimate the total stalks for the 10' x 10' area.

5. Sweep the entire area. Several students should follow the first. Why?



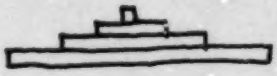
6. Count insects - an approximation since unable to collect all.

   a. Quick "eyeball" of the different species (primary consumers - example, plant bugs, grasshoppers, aphids; secondary consumers - spiders, daddy-long-legs, ...)

b) "Absolute count" - dump insects in alcohol, separate and count.

7. Build a food chain. Who's eating who? Use the organisms listed in the data and the organisms that are known to occur but were not observed.

8. Look at a pyramid of numbers (approximate) for ecosystem. (energy flow diagram)



3° consumer (eg. birds or snakes)
2° consumer (eg. spiders)
1° consumer (eg. plant bugs)
Producers (e.g. grasses and weeds)

9. What are the producers, primary, secondary, tertiary consumers, decomposers, scavengers, parasites?

10. In a city community, identify: the food producers, the first order consumers, the second and third order consumers, the decomposers and transformers, the scavengers, and the parasites.

Questions:

1. What is the original source of energy for both ecosystems?

2. Why are most food chains only four to five links?

3. Why could there not be equal numbers of producers, primary consumers, secondary consumers, ...

4. Trace the flow of energy through the body - from the sun to the ability to read this question.

5. Concerning the animals that were collected, which appeared to be more numerous, first, second, or third order consumers? Which ones were least abundant? Did the results agree with what you expected?

6. How does our rate of energy use compare with that of the natural ecosystem?

7. How could people eat lower on the food chain? What consequences would that have on the food supply if everyone did?

Submitted by: Patti Lease, Art Durow, and John Campbell

Grade Level: 6-12

Title: Tracing a Product and Food to Its Source (Indirect Energy Inputs)

Objective(s):

1. The student will be able to trace a food to its source by listing all the indirect energy inputs that were needed to make the food, take it to market, and discard it.

2. The student will learn that some advantages to using foods low in indirect energy inputs are: less energy used, less pollution produced, cost is lower to the consumer, nutritional value is greater, there are no additives, it is fresher food, it tastes better, etc.

3. The student will understand that generally speaking those products which are more processed use more indirect energy to produce.

4. Students will develop knowledge that some advantages to using foods high in indirect energy inputs are: you can store them for long periods of time, they increase the employment market (more jobs), they are often more convenient to use, you have year around variety, you can export excess to world markets, etc.

5. After weighing the pros and cons the student will make an individual judgment.

Materials:

The following materials are suggested. Others may be substituted.

a fresh potatoe
a fresh sack of potatoes
frozen french fry bag
canned potatoes
mashed potatoe flakes
menu from restaurant with
french fries circled

a fresh ear of corn
a fresh package of corn
box from frozen kernels of corn
canned kernels of corn
corn meal
menu from restaurant with
corn circled

fresh spinach leaves
a fresh bag of spinach
box from frozen spinach
canned spinach
menu from restaurant with
spinach circled

BSCS film loop: "Tracing a Product to Its Source"

Procedures:

1. View the film loop: "Tracing a Product to Its Source"

2. Alone or in groups, select one of the available foods.

3. Trace the food back to its source by listing the indirect energy inputs that were needed to make the food, take it to market, and discard it.

4. Share your list with your class members.

Questions:

1. Which products need less indirect energy inputs to be produced?

2. What are some advantages in using foods low in indirect energy inputs?

3. Which products use more indirect energy inputs to be produced?

4. What are some advantages in using foods high in indirect energy inputs?

5. Do you think we should use high or low indirect energy consuming products? Why?

Bibliography:

Biological Sciences Curriculum Study, ed. Energy and Society: Investigations in Decision Making. Northbrook, Illinois: Hubbard, 1977. p. 14

Film loop: Tracing a Product to Its Source. BSCS

Submitted by: Barbara Porter

Grade Level: 10-12

Title: Discovering Energy Through Individual Research by Students

Objective(s):

To provide an optinum knowledge of energy through student research and student demonstration. (See Study Guide - SIRS)

Materials:

Magazine articles on energy
additional project materials requested by students

Procedures:

1. Have each student select a magazine article on energy based upon interest and reading level.

2. Instruct students in the art of taking notes when listening to, or reading sources of information.

3. Each student must read and research his own article, then present the information to the class.

4. At the end of the unit, each student will have several note-cards representing his own research and other students research.

5. A paper or project must then be submitted in a problem-solving format.

Questions:

1. Identify the symptoms of the problem.
   How do we know a problem exists?

2. Survey all aspects of the problem.
   What is the impact of the issue on different segments of the society?

3. Define the problem.
   What conflicts need to be resolved?

4. Determine the scope of the problem.
   Who is affected - what areas of the community, country or world?

5. Analyze the causes of the problem.
   What factors contribute to the development of the problem?

6. Investigate solutions to the problem.
   What present efforts, proposed remedies, and all other possible alternatives exist for the problem?

Submitted by: J. Randall Mikula

Grade Level: 7-9

Title: Cosmic Cooker

Objective(s):

Students will follow simple directions and construct a solar device and use it to cook a hot dog.

Materials:

cardboard (⅛" - ½")
posterboard (8½" x 13½")
glue (or staple gun, small nails, double stick tape, etc.)
aluminum foil (8½" x 13½")
coat hanger
straight pin
solar foil (aluminum foil with the dull side sprayed with black paint)
hot dog
one sunny day

Procedures:

1. With the use of the pattern on the back of this sheet, copy it twice onto two pieces of cardboard (⅛" - ½") and cut out. These will form the sides of your "Cosmic Cooker".

2. Take your piece of posterboard (8½" x 13½") and attach it to the sides of your "super sunbaker of succulent sustenance." Though a variety of methods, your best bet will probably be a (borrowed) staple gun.

3. Attach a piece of aluminum foil to the inner concave surface of your collector with the shiny side out. (You can purchase posterboard which has already been coated with a highly reflective material or use Mylar with a reflective coating but the cost could prove to be inhibitive.)

4. With your coat hanger (that you probably ripped-off) cut, sand and bend it to form your skewer upon which will sit your tube steak (hot dog).

You are now ready to field test your "Cosmic Cooker" on the sunny day you were to obtain while collecting your materials. Take your skewer and stick it through the first side of your cooker, then through your hot dog and then through the other side of your cooker. Wrap your stuck hot dog with a light coating of solar paper (commercial solar paper can be purchased but the home-made variety works just as well), make sure the shiny side is inside and the black surface is outside. The black coating will increase the heat collecting ability of your cooker and thus increase its efficiency.

Use the straight pin to focus your cooker right into the sun by placing the pin in the middle of the flat edges of one of the sides (make sure its perpendicular to the flat edge) and then turn and tilt it until the shadow of the pin forms a small circle at its base.

COSMIC COOKER

Rationale:

This idea was used to help students grasp the concept that the suns energy can be used as an alternate form of energy to supplement our daily energy needs. Through the construction and use of this cooker they developed an understanding of the principles underwhich this cooker operates and were then able to apply the same ideas to actual examples of solar collecting apparatus and its operation. This experience can be used as a "jumping off" point from which to begin an energy unit or as a culminating type experience to wrap up an energy unit.

Other Applications:

1. This cooker requires a parabolic curve. Students in math classes could research the construction of parabolic curves.

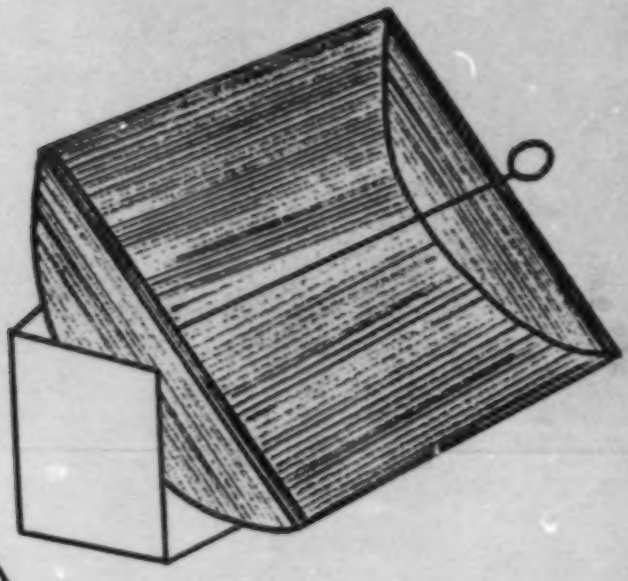
2. This cooker will usually inspire a few to try construction of other simple equipment such as solar food dryers, water heaters, solar ovens or reflectors.

3. This cooker can be used to measure temperatures at different times of the day to determine at what times would its operation be best.

Submitted by: James Rustowicz

Adapted from: Cosmic Cooker: A Learning Experience Science Education Resource Center. American Museum of Atomic Energy.

COSMIC COOKER



Grade Level: 9-12

Title: Energy Sources Discussion

Objective(s):

To discuss the implications involved with renewable and nonrenewable energy sources.

Procedures:

Background information:

NONRENEWABLE SOURCES	RENEWABLE SOURCES
Petroleum - About 68% of U.S. energy comes from oil. U.S. oil fields, including new Alaskan find, now have about a 30-35 year supply left.	Hydroelectric power - Hydroelectric power is relatively "clean" but dams still full and also spoil scenery. This power source accounts for only 4% of the power usage in the U.S.
Natural gas - Demand for natural gas has tripled in last 20 years. In 1941 there was a 33 year supply. Despite huge discoveries since then, there is only about 17 year supply now.	Wind power - Though wind power played an important historic role in man's use of energy - windmills and Yankee clippers - it is of little use today.
Coal - Of nonrenewable fossil fuels, coal is in greatest supply: the U.S. has enough for 350-450 years. One problem is that coal is a "dirty" fuel, causing air pollution problems.	Tidal Power - Even if the world's potential tidal power were fully utilized, it would amount to only 1% of the world's potential hydroelectric power.
Thermonuclear Fusion - Big hope is for development of controlled fusion, low in pollutants.	Photosynthesis - Green plants alone can convert sunbeams into food and usable energy.

Questions: (group discussion)(study the energy chart and answer the following questions)

1. What are nonrenewable energy sources. Why is some energy considered renewable?

2. Of the nonrenewable sources, which is the scarcest? Which of the nonrenewable sources seems to be the most abundant?

3. Can you give any other nonrenewable sources than those given?

4. What energy sources causes the most pollution? What kind of pollution do you suppose is produced? What energy sources caused the least pollution?

5. How can photosynthesis be used as a renewable energy source?

6. Can you give any other renewable sources not mentioned?

7. If we stop using fossil fuels, how will that affect the oil and coal industry?

8. If renewable sources are less pollution, why don't we use them more?

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Information obtained from National Wildlife Magazine, March 1971.

Submitted by: Richard Nader

Grade Level: 7-12

Title: Evaluating Your Attitudes and Concepts About Energy Use

Objective(s):

1. To incorporate an interdisciplinary approach to the study of energy use.
2. To determine one's attitudes with regard to energy use.
3. To change bad energy use practices.
4. To change the family's energy awareness if warranted.

Procedures:

1. Take E.Q. Quiz.
2. Write for free materials.
3. How do you use energy?
4. Alter your energy use.
5. Bring your family through above process.

Questions:

1. How and when do you use energy?
2. What are you willing to do to change yours and others energy use?
3. What are some current energy problems and solutions?
4. Is changing energy use easy?
5. What are short and long term importances of changing energy uses?
6. What is the willingness of your family to participate?
7. What is the willingness of others to change behavior?

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Concern, Inc., 2233 Wisconsin Avenue, N.W., Washington, D.C. 20007

Consumers Power Company, 1030 Featherstone Road, Pontiac, MI 48058

Consumer Communication, The West Bend Company, West Bend, Wisconsin
53095

Submitted by: Thomas Tristani

Test Your E.Q.*

1. ____ How much of the energy used in gas stoves supplies the pilot lights?
a. 10%
b. 25%
c. 50%

____ 2. An incandescent lamp and a fluorescent lamp having the same light output: Which uses energy more efficiently?
a. fluorescent
b. incandescent
c. both about the same efficiency

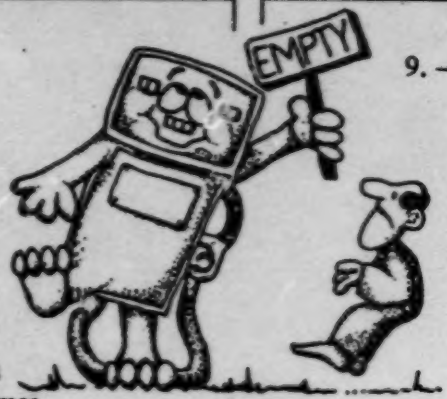
____ 3. How many soft drink cans can be manufactured from recycled aluminum with the energy needed to make a single can from aluminum ore?
a. three
b. five
c. twenty

____ 4. How long would a 100-watt light bulb burn on the energy needed to manufacture one throw-away soft-drink can or bottle?
a. 10 minutes
b. 5 hours
c. 20 hours

____ 5. How much of the energy stored in crude petroleum is lost between the oil well and a moving car?
a. 20%
b. 60%
c. 90%

____6. The heat energy of a gallon of gasoline is equivalent to
a. 5 man-days of labor
b. 15 man-days of labor
c. 25 man-days of labor

____ 7. How much faster than their rate of production are we consuming our fossil fuels?
a. 10 times
b. 1,000 times
c. 1,000,000 times



____ 8. What fraction of the world's energy consumption occurs in the U. S.?
a. over 10%
b. over 20%
c. over 30%

9. ____ Which of the following fuel resources is in greatest danger of exhaustion?
a. coal
b. petroleum
c. natural gas

____ 10. In the year 2000, American total energy demand will be:
a. the same as today
b. twice as much as today
c. three times as much as today

*Energy Quotient.

ANSWERS:

Score 1 for each correct answer.
0-5 Poor, 6-7 Fair, 8-10 Good

1. (c) Approximately half of the gas used in a gas stove is used to fuel the pilot lights because pilot lights burn continuously.

2. (a) Fluorescent lights give off three to four times as much light per watt of electricity used as incandescent lamps do. One 40-watt fluorescent light gives more light than three 60-watt incandescent bulbs (and the annual savings may be as much as $10).

3. (c) Aluminum is a very energy intensive material with the largest share of the energy going to process the ore. Recycling is a great energy saver. The nation's total throwaway containers equivalent energy waste is equal to the output of 10 large nuclear power plants.

4. (b) A 100-watt lamp could burn for 5 hours on the energy used to manufacture a disposable can or bottle.

5. (c) Ninety-four per cent of the energy in the gasoline from crude petroleum is lost in making your car move. The efficiencies of the most important steps where energy is lost are:

producing the crude oil	96%
refining	87%
gasoline transport	97%
engine thermal efficiency	29%
engine mechanical efficiency	71%
rolling efficiency	30%

The total efficiency of the system is found by multiplying the six factors together: 6%

6. (b) 15 man-days of labor. Said in another way, one barrel of oil contains heat energy equivalent to the energy of a man at hard labor for 2 years.

7. (c) In less than 500 years man will have consumed essentially all of the coal, oil, and gas that nature started forming 500,000,000 years ago. By comparison, the same fraction of a calendar year is approximately 30 seconds.

8. (c) More than a third of the world's energy is consumed by the 6% of the world's population residing in the United States.

9. (c) Natural gas reserves in the U.S. are expected to be exhausted in about 40 years. Petroleum should last for a century. Coal, 500 years or so.

10. (b) For more than a century, American demand for energy has doubled, on the average, every 20-25 years.

NRG OPINIONS

Some possible ways you could try to solve the energy problems are listed below. Choose the three actions that you think are the most practical and effective ways to solve energy problems. Mark each of these actions with an "M" for MOST. Then choose the three actions that seem to you the least practical and effective. Mark each of these with an "L" for LEAST. Next write out your reasons for your choices. Finally, share them with the group.

_____1. Attend your city council meetings. Urge councilmen to pass a law that would close any business that uses excessive amounts of energy. Standards could be federally determined.

_____2. Do everything you can to reduce your personal energy consumption and hope that others will learn to do the same.

_____3. Write a "letter to the editor" of the local newspaper. Explaining the need to be energy conscious and urging others to become involved in our energy problems and help to seek solutions.

_____4. Support a government plan to stockpile fossil fuels to insure our country's energy needs will be met in the future.

_____5. Support a campaign to force the state government to pass an "anticar" law. No family would be allowed to own more than one car.

_____6. Write your state representative and urge him to support this proposal: American should switch entirely to nuclear power for their energy source since we will very soon be running out of fossil fuels.

_____7. Tell your local government to require land and business developers to begin to investigate solar and wind energy to service new buildings.

_____8. Take part in a demonstration against large buildings in the downtown area and malls in the suburbs that soak up huge amounts of energy in heating and cooling.

_____9. Support an election proposal to raise money for research concerning alternative energy sources. The research would cost taxpayers at least one hundred million dollars.

Reasons for my Choices:

HOW TO USE NRG CHECKLIST

1. Observe yourself.

2. Check areas where you are conserving energy.

3. Choose five areas where you don't conserve energy.

4. Keep a journal. Watch yourself without initiating any change.

5. Keep a journal, while you work to conserve in five areas.

6. After successfully conserving some of your own energy wastes, discuss the energy situation with your family. Ask them to give up some of their time for a week.

7. Bring family through NRG Opinions, E.Q. Quiz or any collected data.

8. Go over your NRG Checklist with your family. Update your list with everyone's input. Determine five ways or more to conserve energy with the whole family. Work on a plan together.

9. Keep a current family energy file of news and magazine articles and summaries of radio and TV news.

10. Every one can nightly enter into the journal the daily experiences of energy saving.

11. Family discussion at the end of the week.

    a. read journal entrees

    b. summarize news items

    c. what was the whole experience worth

        (1) short term effects

        (2) long term effects

NRG CHECKLIST

Transportation

_____Buy a car no larger or more powerful than you need, without unnecessary features.
_____Walk and ride bikes. Half of all automobiles trips now cover less than five miles.
_____Ride public transportation where available.
_____Organize car pools.
_____Encourage the building of better public transportation systems in your community.
_____Have your car periodically maintained and keep it tuned up.
_____Speeding is a costly consumer of fuel. The average car driven between 75 and 80 miles per hour will consume almost twice as much fuel per mile as the same car driven at 50 miles per hour.
_____On the road, accelerate smoothly and ease into stops.
_____Do not race the engine.
_____Instead of idling the engine to warm it up in winter, drive slowly for the first quarter mile.
_____Do not leave your engine running longer than 3 minutes while waiting.

Heating

_____Weather strip and caulk windows and doors.
_____Install storm windows and doors.
_____Close damper in fireplace when not in use.
_____Lower thermostat for sleeping. We suggest 60.
_____By lowering the daytime setting of your thermostat by 1, you use 3% to 4% less fuel. By lowering it 5, you use 15% to 20% less fuel.
_____Insulate your body, wear a sweater.
_____Discourage over-heating of public buildings, particularly schools and libraries. Pressure managers of public buildings to conserve energy.
_____Insulation provides the greatest single opportunity for energy conservation in your home. Be sure you have at least 6" of quality insulation in your top floor ceiling or attic floor.
_____Normally, heating represents, by far, the largest single use of energy in your home. Keep your heating system in good operating condition and replace filters at least twice a year.
_____Vents on dryers, range hoods and bathroom ventilating fans should have dampers that close properly.

Cooling

_____All buildings should have windows that open.
_____Encourage the design of buildings with less glass.
_____Shade windows from direct sunlight. Preferably shade them from the outside with trees, window, vines, shutters that close, awnings or roof overhangs.
_____Close light colored draperies to the sunlight. This can reduce heat gain by 50%

_____Illuminate less.
_____Window air conditioners and compressor sections of central systems should be properly sized and placed on the north side or the shaded area of your home. They will operate more efficiently in these cooler locations.
_____Discourage open refrigerator units in supermarkets to display frozen vegetables and dairy products.
_____Complain about over-cooling in public places; particularly theatres, restaurants and supermarkets.
_____Avoid using air conditioner unless weather is intolerable.

Appliances

_____Baths require more water than showers. A normal bath requires 23 gallons of water at 110°F. A normal shower of 3 to 4 minutes requires 12 gallons of water at 110°F.
_____Clean or check the lint screen on your clothes dryer after each load for most efficient drying.
_____Defrost manual-defrosting refrigerators regularly. Don't allow more than ¼-inch of frost to build up.
_____Gas appliances should be operated with proper burner adjustment (blue flame) to conserve gas. Gas appliances without pilots mean gas conservation.
_____Just don't let hot water run while washing or shaving. Instead partially fill the basin with hot water.
_____Microwave ovens provide energy savings in a variety of cooking applications.
_____Oversized appliances waste energy.
_____Read carefully the instructions on proper care and operation of your appliances.
_____Self-defrosting refrigerators or freezers can use as much as 50% more energy to operate than a manual defrost model. Check for self-defrost models that use a minimum of energy.
_____Whenever possible run washing machine on cold water.
_____Eliminate use of unnecessary appliances.
_____Try to avoid using your appliences during peak periods of energy use.

Cooking

_____Porcelain finishes retain received heat and allow for cooking on lower heat settings as compared to plain metal appliances.
_____Don't overload electric circuits with high wattage appliances; 1600 watts is the limit for each electric circuit. If circuits are overloaded, cooking times will be increased and the appliance will not function properly.
_____If an extension cord is used, make sure the wattage of the extension cord is equal to or greater than the appliance.
_____Always turn an appliance off when not in use. Unplug cord after each use; this will prevent such accidents as bumping the temperature control "on" or flipping the appliance over.
_____Thaw frozen meats and poultry before heating.
_____Keep portable appliances out of drafts. Cooler air circulating near or around an appliance can reduce its efficiency.

_____Divide an electric skillet with foil inserts to prepare or warm several small dishes at the same time.
_____Place pan on surface unit before turning the heat on.
_____Use the right size pan that fits the range top unit. Flat-bottomed, straight-sided pans with tight fitting covers are best.
_____Use high heat to bring foods and water to a boil, then turn heat control to simmer for remainder of cooking period. Slightly boiling water is the same temperature as water tossing about wildly.
_____Use a minimum of water in cooking to shorten cooking time. Low heat and snug-fitting covers make such "minimum moisture" cooking possible.
_____For better heat reflection, keep chrome and steel reflector pans underneath surface units shiny-clean.
_____Double or triple recipes for later use.
_____Don't open the oven door while foods are being heated. The average "peek" causes the oven temperature to drop 25-75 degrees.
_____By turning the oven off a few minutes before food is cooked, the residual heat in the oven will complete the cooking.
_____Use self-cleaning cycle of oven less frequently.

Lighting

_____Fluorescent lights are more efficient than incandescent.
_____Use lights in specific work areas, instead of lighting the entire room.
_____Turn off lights when room is not used.
_____If you have a television set with the instant turn-on feature, unplug set when not in use.

Recycling

_____Demand and buy goods made of recycled materials.
_____Use aluminum sparingly, save and reuse.
_____Take all aluminum waste to your recycling center.
_____Urge your stores to stock returnable bottles. Buy them and return them.
_____Take newspapers to recycling center.
_____Demand that products be made to last.

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Grade Level: 7-12

Title: Cookie Concerns

Objective(s):

Understanding to be developed: humans and natural resources are distributed unevenly around the earth.

Materials:

bag of cookies with enough for everyone in the classroom
tape recorder and tape

Procedures:

ACTIVITY ONE

1. Dump the cookies out into two equal piles on separate trays - start the tape.

2. Give one tray to two people in the class and tell them they may have all they want to eat of the pile.

3. Give the other tray to the rest of the class to share. There should not be enough to go around in this pile. Be sure to notice every detail of behavior that takes place here.

4. Let things go for a while without comment or explanation. They are role playing without knowing it.

5. Ask them to settle down and stop the recorder.

Questions:

1. Do you know why this activity was done?

2. If cookies represent all the natural resources and wealth in the world, who do you suppose the two people with half the cookies represent?

3. How did the rest of you feel? Do you suppose the poor in India, Brazil or Mexico feel the same way?

4. How did the two Americans feel about their position in the class activity? Do you think your feelings are similar to the way the American public seems to feel about the lack of food, medicine and conveniences in other parts of the world?

5. Play back the tape and stop to discuss interesting comments, trying to equate them to current world crises.

Title: Natural Resources vs. World Power

Objective(s):

Understanding to be developed: humans and natural resources are distributed unevenly around the world.

Materials:

library
pencils and a felt pen (one color)
data tables for students
large data table for classroom use (poster board)

	Population	Water	Forests	Uranium or Plutonium	Petroleum	Agriculture Fertile Soil	Major Natural Resources
United States							
Soviet Union							
India							
The Netherlands							
China							
Chad							
Canada							
Kuwait							

Procedures:

ACTIVITY TWO

1. Prepare copies of the chart for each student.
2. Prepare a large copy of chart for classroom use.
3. Make sure students understand what a natural resource is.
4. Students are to find out by library research if each of the countries listed have each of the natural resources listed.
5. Students should indicate on their chart if the country has the resource, and if it is considered a major resource in that country.
6. Students should also find the population of the country and list it on the chart.
7. Students should also find the major resource of each country and list it.

8. When all the information has been gathered it can be entered on the large chart by the following method: If a country has the resource listed as a major resource, color in the appropriate block. Fill in population number and the major natural resource.

9. The chart should be done in all one color felt pen to eliminate the confusion of a number of colors on the chart.

Questions:

1. What is world power? How is it determined?

2. What are the countries with the greatest and the least natural resources?

3. Can you see a relation between a country's natural resources and its position as a world power?

4. Are there any countries with a lot of natural resources but with very little world power?

5. If you were in a government with a lot of natural resources but with little world power, what could you do to obtain more world power? Can you give any examples of methods which some governments have actually used?

6. What is supply and demand?

7. Why do some countries with many natural resources have so little power? Are these countries using their natural resources wisely? Could there be other reasons for their lack of power?

8. Does the population of a country necessarily make it a world power or a strong country? Can a very large population in a country be more of a disadvantage than an advantage? Can you give examples?

9. What are some other important natural resources besides the ones listed on the chart?

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Ideas adapted by: Cheryll Greene

Grade Level: 7-12

Title: Solar Energy Research Project

Objective(s):

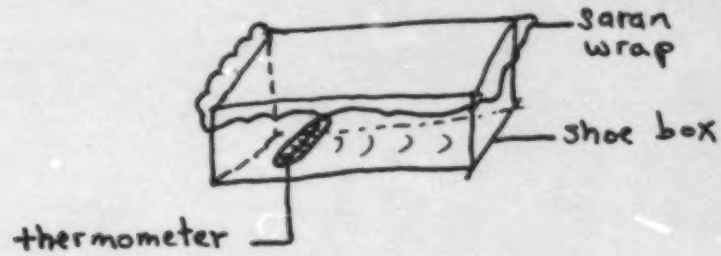
To investigate the effect of color and texture on solar energy boxes.

Materials:

shoe boxes
various colored construction paper
black construction paper
scissors
glue
saran wrap
thermometers

Procedures:

1. Work in groups of four.
2. Each group lines one box with black construction paper and one box with any color they think might absorb heat.
3. Glue the paper in the box, both on the sides and on the bottom.
4. Using the scissors, cut some matching paper into strips, circles or rectangles, etc.
5. Glue into place in the bottom of the box (to increase surface area). One box should be made with no increased surface area to be used as a control.
6. Place the thermometers in the bottoms of the boxes and put saran wrap over the tops of the boxes.
7. Take the boxes outside and set them so they receive maximum sunlight



Observations:

1. After about 10 minutes, compare the temperature in the black box and the other box.
2. Compare the black boxes to see which type of surface area absorbs the most heat.
3. Compare the effect of tilting the shoe boxes at different angles to the sun.

Grade 1st

Conclusion:

1. From your observations, which color box absorbed the most radiation? (Which has the highest temperature?)

2. What effect does the increased surface area have on the amount of radiation absorbed? (What is the temperature of the control box compared with the box with increased surface area?)

3. Which type of increased surface area worked the best?

Questions: (class discussion)

1. If you were going to make a solar energy unit to put on the roof of your house, what factors would you have to consider?

2. Once you have captured the solar energy in the box, how can you convert it to heat in your house?

3. What are some of the positive aspects of using solar energy?

4. What are some of the negative aspects of using solar energy?

5. What could you do if your neighbors tree grew up and shaded your solar energy unit?

6. Do you think solar energy can and will be a major energy source in the future?

7. Since solar energy is "free" after the initial cost of building and installing the solar energy unit, do you think the Federal Government should spend money to investigate and develop solar energy as an alternative energy resource?

8. What advantages does solar energy have over other alternative energy sources, such as nuclear fission, water power, garbage, wind, and geothermal energy?

9. In what other ways can solar energy be used besides heating homes and water?

10. What is the environmental impact when solar energy is used?

Submitted by: Barbara Dempster

Law of Conservation of Energy

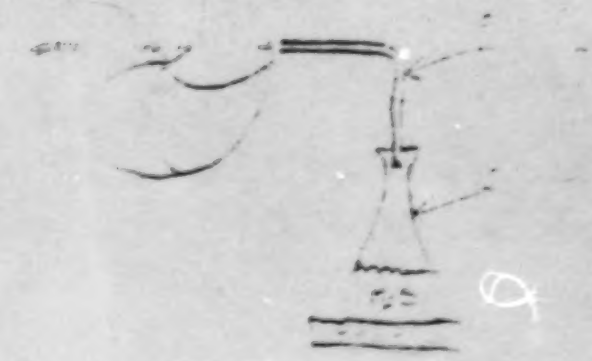
Grade Level: 7-12

Title: Law of Conservation of Energy

Objective(s):

To show how energy is neither created nor destroyed, but simply changed from one form into another.

Materials:



Activity 1:

bunsen burner or hot plate
400 ml. Erlenmeyer flask
(1) hole rubber stopper
90° bend glass tubing
250 ml. beaker
(2) ring stands
test tube
thermometer (°C)
NaOH crystals
meter wheel (light weight)
9" length of 1½" diameter glass tubing

Activity 2:

Ammonium dichromate
Magnesium ribbon
crucible or ovenware dish
tray to catch ash

Activity 3:

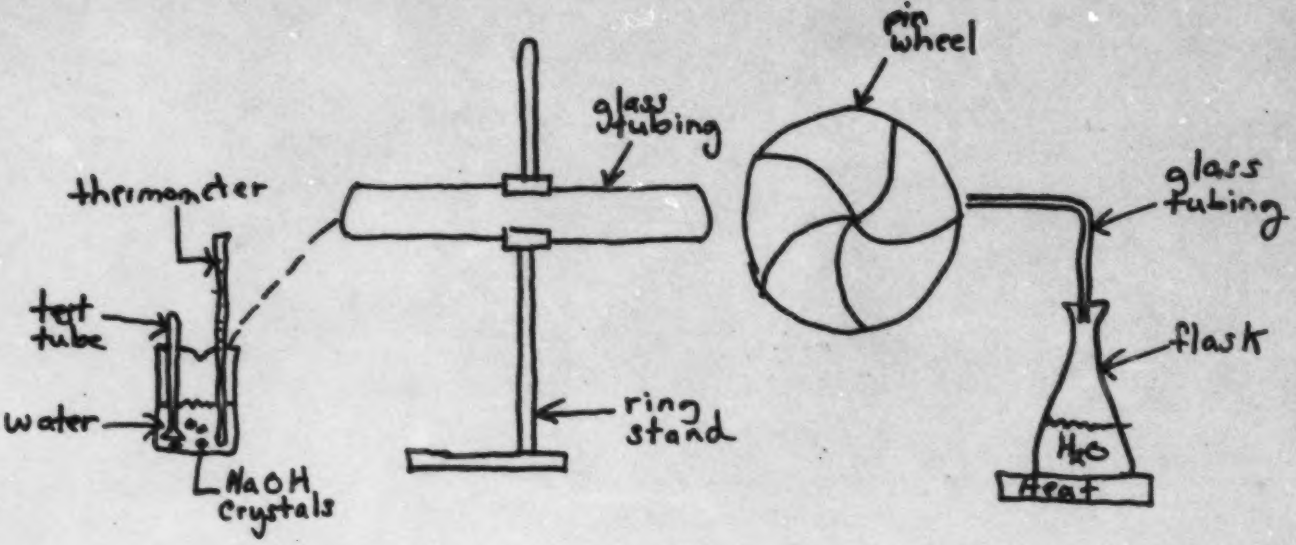
light bulb
tin can lid
tin snips
fine wire

Procedures:

Activity 1:

Set up demonstration as shown in the diagram. Use caution in handling the hydroxide. Set system in motion as water comes to boil with heat energy at 212°F. It forms steam which is directed onto the pin wheel where it causes it to revolve. Water running off the water wheel is directed into the tubing and into the beaker where it combines with the sodium hydroxide in a chemical release that heats the water in the test tube.

Forms of energy used are electrical (or fossil fuel), heat, chemical, and heat again. Is some energy "lost" or dissipated in the system? At what points do you believe some heat is lost?



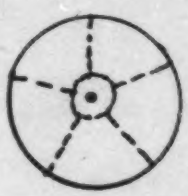
Activity 2:

Place a crucible or small dish on a tray. In the crucible place 2 tablespoonsful of ammonium dichromate. Place a 2-inch length of magnesium ribbon into the chemical and light it.

The resulting display of a "volcanic" eruption will provide a very dramatic display of chemical energy, heat and light.

Activity 3:

Find the center of the can lid and dent it in with a nail. Draw a 1" circle around the center. With the tinsnips cut into the circle edge at regular intervals around the edge, as:



Bend one edge of each vane blade slightly to one side. With the wire, form a circle that will fit over the light bulb so that one free and extends to the center of the bulb and projects upward. Balance the spinner center dent on the projecting wire "pin". When the light is lighted the heat energy from the bulb will warm the air and cause the vane to spin. (If it is not balanced, some careful trimming of blades of the vane will help.)

Questions:

1. What forms of energy have you seen at work?

2. What is the source of all these forms?

3. Devise a solar reflector from a tin pie plate and use a thermometer to measure the heat "collected" (focused at a point).

Bibliography:

Glen Erickson. "Baker's Doman," Environmental Education Activities Manual. (Jr. High), ed., Stapp & Cox, 1974, pp. 144-145.

B. Diane Boyd. "You and Energy," Environmental Education Activities Manual. (Upper Elementary), ed., Stapp & Cox, 1974, pp. 31-32.

Michael D. O'Farrell. "Study in Demand and Consumption of Natural Resources," Environmental Education Activities Manual. (Jr. High), ed., Stapp & Cox, 1974, pp. 53-54.

Mary Lou Hess. "Energy Changes," Environmental Education Activities Manual. (Upper Elementary), ed., Stapp & Cox, 1974, pp. 18-20.

Submitted by: Br. Xavier Pankovits

Grade Level: 4-8

Title: Windwheel Energy Sources

Objective(s):

To demonstrate the theory behind energy sources and the practical applications.

Procedures:

Using a plastic windwheel (pinwheel), students can demonstrate how each energy source provides the energy to turn the wheel.

1. Windpower: Blow on the wheel and it will spin, increasing the amount of wind (bu use of a fan) will increase the visible amount of energy to turn the wheel.

2. Burning of solid waste: Using form of waste material, burn this waste in a heat resistant beaker. Place a heat resistant funnel over the top of the beaker and hold the wheel over the funnel. The rising heat will cause the wheel to spin.

3. Solar Energy: Your students may have seen solar energy in action by use of a magnifying glass. Hold a magnifying glass between the sun and the wheel and watch the wheel begin to turn.

4. Geothermal: You can demonstrate this by using a whistling tea pot and boiling water. When water reaches the boiling point, the pressure will push the steam against the inside of the pot and it will begin to escape. When the pot whistles hold the pinwheel over the spout. The wheel will turn.

5. Coal: Burning coal will produce heat to turn the wheel, but you can also demonstrate some of the byproducts of coal. Hold a sheet of glass over burning coal. This will produce a smudge. Have the students feel the smudge to feel the oily property. Researchers hope to use this in the future.

Bibliography:

Schools Can Conserve Energy, Too. U.S. Department of Energy, Office of Marketing and Education, Washington, D.C. 20545

Submitted by: Helen Trahey

Grade Level:

Title: Energy

Objective(s):

To study energy as a renewable resource.

Materials:

100 ml beaker
thermometer
50 ml H_2O
magnifying glass
watch

Procedures: (to be done on a sunny day)

1. Pour 50 ml of H_2O in a 100 ml beaker and take it outside to a sunny spot. Measure the initial temperature of H_2O record.
2. Take a magnifying glass 3-4 times larger than the beaker and converge the sun rays "into" the beaker. (Can be done also without magnifying glass, but it would take longer.) Continue this activity for 10 minutes. At this time measure the temperature and record again.
3. Final temperature
   - Initial temperature
   - Change in H_2O temperature

   Heat obtained = Lt. x Wt. of H_2O/per 10 min. on a given day

Conclusions:

1. This provides a quantative means of measuring energy - rather than getting a sunburn as proof of energy from the sun.
2. Compare results with the rest of the class. Take the average value and show deviations.

Submitted by: Vitalija Kebbys

Grade Level: 10-12

Title: Energy for the Future

Objective(s):

1. To teach safe use of hand tools, machines and planning.
2. Correlate science and industrial arts.
3. Teach research techniques.
4. Make students aware of our energy problems.
5. Add an energy unit to our course of study.

Materials:

plastic
wood
paint
metal
screws

Procedures:

1. Class discussion of energy.
2. Design a model or working project of an energy alternative.
3. Construct the project.
4. Display projects in showcase.

Questions: (discussion)

1. What is energy?
2. Name three types of energy.
3. What can our class do to make our community aware of our country's energy problems?
4. Name the pros and cons of solar, nuclear, geothermal, solid wastes, wind, oceanthermal gradients, tidal power and hydro-electric energy.
5. Pick an energy alternative and gather information. (Take a survey, call agencies, write letters, talk to people, write congressmen, develop a clipping file.)
6. Pick a group and report your findings to the class.

Bibliography:

U.S. Department of Energy Weekly announcements information available from the DOE Office of Public Affairs, Washington, D.C. 20461

Energy and Education Action Center in Washington, D.C., operating out of U.S. Office of Education. The Center is directed by Wilton Anderson and should emerge as a source of energy related to teachers.

The Bureau of Occupational and Adult Ed. (USOE) Division of Research and Demonstration.

The Journal published by the National Ed. Council of Energy and Power P.O. Box 618, Concord, MA 01742.

The National Advisory Council on Vocational Education, 425-13th St., N.W., Suite 412, Washington, D.C. 20004.

Submitted by: R. DeLashmit, V. Desanto, and M. Schultz

Grade Level: 7-12

Title: Alternative Sources of Energy

Objective(s):

1. The student will understand some sources of energy, and that they are limited. Student will also become aware that there are many possible alternatives to consider.

2. Review kinds of energy resources, discussing those that are inexhaustible such as sun and wind; and those that are non-renewable like coal, natural gas and petroleum.

Materials:

Popular Science magazines

Procedures:

Listed below are energy sources whose supplies are dwindling. Using Popular Science magazine, the student will choose an alternative, present an illustration, a written and oral report, and compose a short quiz on the subject.

ELECTRICITY	GASOLINE
a. windmills	a. methanol
b. solar heating	b. potatoes
c. solar cooling	c. airmobile
d. waves	d. solar power

Questions:

1. From what energy source does this device get its power?

2. Name some uses for the energy it produces.

3. Is there any reason to believe this device is impractical? Explain your answer.

4. Give reasons why this device will or will not be in use soon.

Bibliography:

Popular Science issues

Submitted by: Mary LeBlanc

Grade Level: 7-12

Title: Environmental Problem Simulation

Objective(s):

Upon completion of this activity, a student should be able to:

1. Identify a potential environmental problem.
2. Recognize divergent interests at stake in making environmental choices.
3. Make a decision balancing the interests of all concerned.
4. Describe the feelings of people having various interests at stake.

Materials:

3 x 5 cards

Procedures:

1. Allow time for students to "research" thermal pollution before the hearing.
2. Allow time at the end of the hearing for questions and discussions.

ACTIVITY

ENVIRONMENTAL PROBLEMS SIMULATION

The Ramada City Planning Department will hold a public hearing Thursday evening to decide whether or not to allow a utility company to build a power plant on the Crook River. Currently (no pun intended) Ramada purchases it's power from the city of Salem. Backers of the new plant contend that it will provide new jobs, increased tax revenue and lower utility bills. Opponents fear the plant will make the river unfit for game fish. They point out that power plants use river water to cool the steam that is used to drive the generators. This increased water temperature decreases the dissolved oxygen in the river, thus killing the fish. Salmon are very important to Ramada businesses. The population often triples during the salmon run as people from all over the state come to catch the fish.

On a 3x5 card, you will find a description of a citizen at the hearing. Choose one and take the position you feel that the person would express at the meeting.

DAVID SCOTT

1. Medical doctor who lives in Salem. He owns a cottage one mile down stream from the proposed power plant site.

2. Enjoys fishing from his property and visits his cottage almost every weekend to "get away from it all."

3. Lifetime member of the Sierra Club.

LORI WILT

1. Presently unemployed, majored in ecology at Greentrees College.

2. Looking for work in her home town of Ramada. Wants to make enough money to return to school and finish her degree.

BEN JASON

1. President of the Ramada Chamber of Commerce.

2. Favorite hobbies are tennis and handball.

3. Wife is President of the Ramada Garden Club.

SARA CLINE

1. Owner of Cline's Sporting Goods, which makes enough money during the salmon season to show a profit for the year.

2. Owns a large cottage very close to the proposed power plant site.

3. Her hobbies include camping, hiking and fishing.

SUSAN HILL

1. Widowed wife.

2. Lives in a small house in Ramada on a limited fixed income.

3. Seldom leaves her neighborhood and rarely sees the Crook River.

STANLEY TIBBS

1. Public Relations Representative for Utility Company.

2. Moved to Ramada 10 years ago and last year ran for city council on a "pregressive" platform.

Questions:

1. What things on the card helped you decide what side to take at the hearing?

2. What were the environmental problems and the consequences for the town and people of Ramada?

3. How do you think the problem will be best resolved?

4. How would you feel about the proposed power plant if you were:

   a) David Scott
   b) Lori Wilt
   c) Ben Jason
   d) the land owner whose property was being used for the plant
   e) a local salmon fisherman
   f) others

5. What other alternatives might be open to the city as a means of generating new power?

Submitted by: Dan Oden

Grade Level: 7-9

Title: Its a Bird, Its a Plane, Its ...

Objective(s):

1. Reinforce understanding of how a reaction engine works.
2. Students will develop the concept that the shape of an object affects the amount of wind resistance (drag) that is produced.
3. Students will reinforce and expand their knowledge of range finding.
4. Students will develop the concept that an increase in air resistance means a decrease in machine efficiency.
5. Students will develop the concept that mass transit devices may trade off air resistance design for more passengers and still be energy efficient.

Materials:

Class Project

three (3) beginning level rocket models
(Alpha II's can sometimes be gotten from Estes Ind. free of charge)
six (6) meter sticks with ¼ inch hole 1cm from the end
three (3) ¼ inch bolts and wingnuts
three (3) chalkboard protractors (from Math Dept.)
class set of rulers
class set of protractors (student)
graph paper
launch equipment (see model directions)

Student Project

same as above only with a class set of rocket models, launch equipment, etc.
three (3) chalkboard compasses also work in place of meter stick and bolts

Teacher Procedures:

Class Project

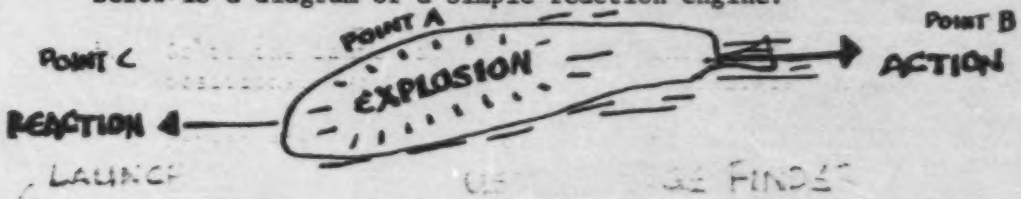
1. Assemble rockets as per directions but reshape nose cones as below.

2. Check with local Fire Marshall for any local regulations on rocketry.
3. Test all rockets for stability before class (see The Model Rocketry Technical Manual).

4. Review all safety procedures with class.

Review:

Recall our class work on reaction engines. There are no moving parts in the simplest form of this type of engine, however, modern jet engines have compressing fans and other types of related equipment. Below is a diagram of a simple reaction engine.



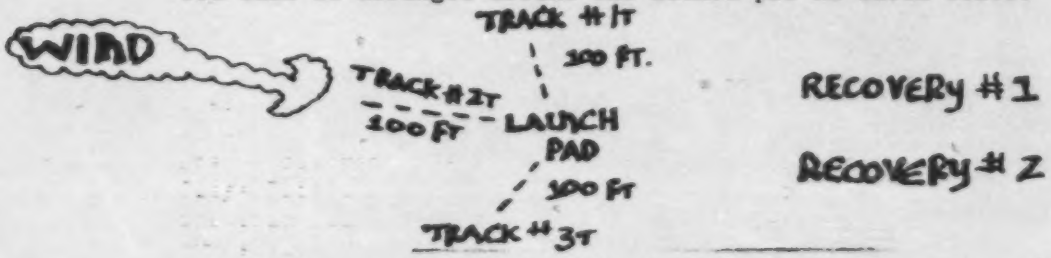
As fuel burns (at point A) gases are made to heat up and expand, this causes an uneven pressure in the engine since the gases can escape only at the rear of the engine. The uneven pressure and escaping gas (point B) is the action which produces an equal but opposite reaction (point C), the engine moving. The faster the gas of the larger the amount of gas escaping the greater is the action and the resulting reaction.

Student Procedures:

1. Examine the three rockets in the front of the room. They are of the same weight, and each has the same size and type of reaction engine.

   Which rocket will go the highest?
   Why did you pick this rocket over the other two?

2. The class will be divided into five teams. Three teams will track the rockets, and two teams will act as recovery units. You will be arranged around the launch pad as shown below.



   Why are the launch teams up wind from the launch point? (HINT: why are the recovery units down wind?)

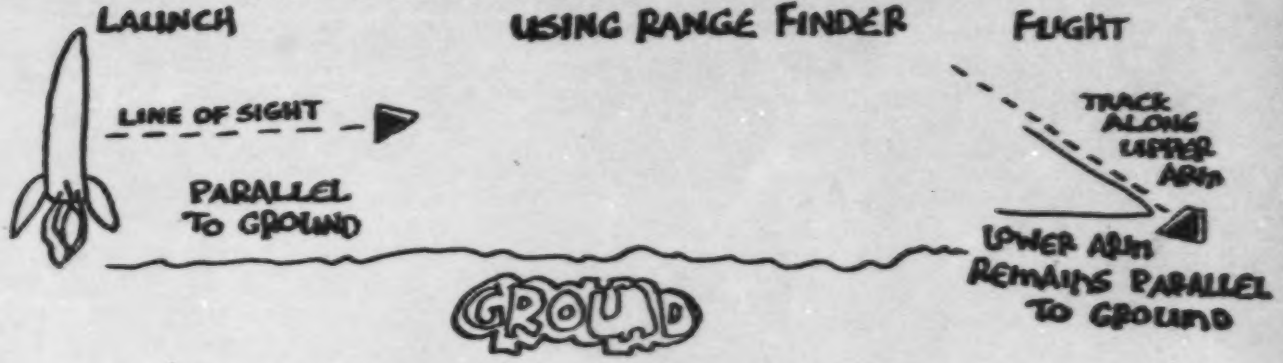
   What is the name of the instrument we have used to measure how far away an object is - without going to the object?

3. The range finder we are going to use is similar to the compasses that you have used in math class. The tracking teams will hold the lower arm parallel to the ground and follow the rockets path by sighting along the upper arm.

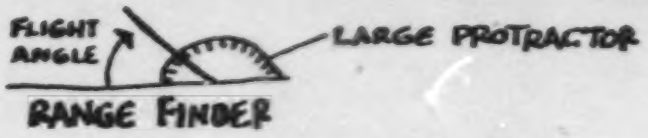
4. The data (angle between the arms of the range finder) will be placed in your data table after each flight, under the correct type of nose cone.

5. Go to the launch site. Tracking and recovery teams take your positions. Go through countdown checklists. 3..2..1..launch!

6. Repeat step 5 for each rocket launch.



FINDING FLIGHT ANGLE AT HIGHEST POINT



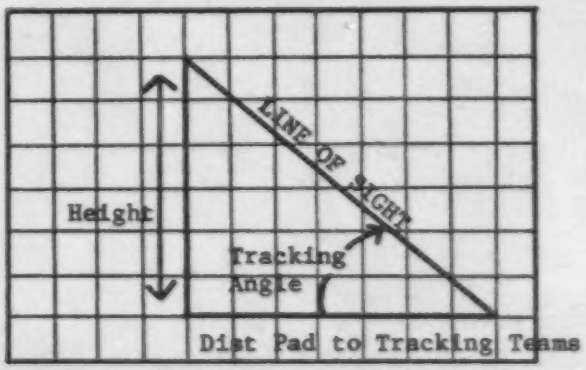
7. Record all tracking data in a Class Flight Log. Determine the average angle for each flight and place it in the Log.

8. Draw a diagram of each flight, using the information in your Class Flight Log. Make the drawing to scale (each square on the graph paper equals a set number of feet), you pick your own scale.

EXAMPLE:

SCALE

1:10



9. Determine the height of each flight and record it in your Log. Remember that the tracking teams were not at ground level, assume that all trackers were five feet tall.

What other assumption do we have to make to determine the height in this manner?

Was your prediction in the second question correct?

Why did the heights vary?

What other factors could affect the rockets heights?

10. List the rockets in order of efficiency, highest to lowest.

Which is the more efficient shape of automobiles - passenger cars or vans? Why?

If the only variable were shape, which automobile would get the most gas mileage? Why?

If machine efficiency could be improved, how might the energy shortage be affected?

Could a rocket or automobile be more energy efficient if it was of a design that increased air resistance but carried more than 3 or 4 people?

Would a mass transit system, such as a subway or monorail, conserve energy or simply be an expensive novelty?

Should gasoline be rationed?

Does your family own 3 or more cars?

Do you feel this many cars are really necessary?

Do you think we should build more superhighways for cars?

Should the "Big 3" auto companies be forced to develop more efficient engines for single family vehicles? Why or why not?

What happens to the average family when gasoline becomes too expensive to buy ($10 - $20 per gallon)?

If you were the President of the U.S., what steps would you take now, and in the near future, to delay the energy crisis?

Bibliography:

Aerospace Education and Model Rocketry. Estes Industries.

Alpha Book of Model Rocketry. Estes Industries.

Model Rocketry Technical Manual. Estes Industries.

Model Rocket News. Estes Industries.

Submitted by: Jim Newman and Larry Schultz

Grade Level: 8-10

Title: Running Out of Energy

Objective(s):

1. To acquaint students with the world wide dilemma associated with the depletion of energy sources.

2. To make students aware of the necessity for the development of new technology so that alternative sources of energy may be tapped.

Materials:

The instruction and discussion in this unit will be based primarily on two publications:

1. "Running Out of Energy", a Cooperative Extension Bulletin

2. "Energy and Environment", a booklet produced by the Energy Research and Development Administration

Following reading and discussing these two publications the unit will be culminated by the classroom use of the Energy Environment Simulator which can be borrowed from the Energy Research and Development Corporation.

Procedures:

The energy unit is written for approximately four class periods. To open discussion and to provide students with their initial information the bulletin, "Running Out of Energy" will be read. The other source of information will be Energy and the Environment. These two booklets will be the focal points of a two day discussion regarding the problems associated with energy consumption and the need for alternative sources. The third day of the unit will be spent with the classroom use of the Energy Environment Simulator. This is a very dramatic means of bringing home the energy problem. The simulator is an analog computer with four control panels which are operated by the students. The students control all aspects of the demonstration, i.e., the rate of use of energy; the shifting to different sources of energy and the development of new technology.

The final day of the unit will be used for a debriefing and culminating discussion regarding the use of the simulator and the information learned relative to the energy problem.

Bibliography:

"Running Out of Energy," Extention Bulletin E 1173, November 1977, Cooperative Extension Service.

Energy and the Environment, Energy Research and Development Administration.

Training in the use of the Energy Environment Simulator can be arranged by contacting Dr. David Sokoloff, U of M Dearborn - Science Department. After the training has been received the simulator can be borrowed for classroom use.

Submitted by: James Potter

Grade Level: 9-12

Title: A B.T.U. Saved is a B.T.U. Earned

Objective(s):

1. How can a student change things in his home, so as to conserve electricity, gas and or oil.

2. The population of the USA is still slowly climbing and the people expect to make a very high standard of living. Stopping waste is the only practical way to allow maximum use of material and minimum environmental impact.

Procedures:

Make a list of the things which you can change plus list the amount of savings.

In your house how could you conserve energy:

Examples:	dial down and wear sweaters	save 20%
	reduce water heater from 160° to 120°	5%
	take quick showers	½%
	use cold water laundry detergent	1%
	turn off unused lights, TV, stereo	2%

In your house what could you buy and add which could lead to a practical savings:

Examples:	insulate ceiling with R-24 fiberglas	save 25%
	foam walls to R-14	14%
	buy energy efficient refrigerator	5%
	buy energy efficient furnace	12%
	install efficient hot water heater	15%
	install extra thermo pane wood windows	10%
	install door closer devices like springs	1%
	seal up windows and doors which are not used	3%

If you could design your own home with energy as a key factor and money not so critical what sort of design changes would you suggest:

Examples:

(a) Round or square home reduces surface to volume ratio.
(b) South facing windows with shudders for night use.
(c) North windows reduced or absent.
(d) No movable windows would cut dramatically air infiltration
(e) Triple glazed wood windows.
(f) 12-15 inches of fiberglass insulation in roof.
(g) Walls with 6-8 inches space with no studs for at least 10-12 foot cent.

(h) Basement or underground homes can use the earths 55°F constant temp.
(i) Low ceilings means reduced volume per room.
(j) Have large overhang to reduce summer light infiltration, but to accept direct winter rays.
(k) Heat house with hydrogen fuel cells generated from the electric wind generator.
(l) Use conservation toilet, urinal, drinking fountain, shower head.
(m) Use oversize electrical wire to reduce wasted heat in wire.
(n) Decrease load per electrical circuit.
(o) Use florescent light fixtures instead of incondescent light bulbs.

Design and draw an efficient house considering conservation of energy (electricity, gas, & oil) water, light, heat, etc...

Questions:

1. What methods are practical and efficient?

   Wind power generation in many areas.
   Solar heat generation in places south of Chicago for hot water and house heat at Virginia line to keep cost reasonable.

2. What methods are expensive but efficient?

   Automatic shutters to close for the low or no sun condition.
   Solar heat generation in Michigan.
   Radar-microwave ranges work well with less energy consumption.
   Heat pump using well water for the sink.

3. What methods are efficient and inexpensive?

   Conservation methods: closing refrigerator quickly-small light bulb disconnect
   defrost mechanism
   don't use coil in dishwasher

4. What changes have you already made in your house?

   Installed smaller light bulb in refrigerator.
   Sealed windows and unused doors.
   Dialed down at nite and during the rest of the time, less.

5. What changes do you hope to make in the future?

   Redesign house with as many factors as practically possible on a budget.

Submitted by: Dean Lande

Grade Level: 7-12

Title: Cost Comparison of Electric Bills

Objective(s):

1. To increase student awareness of and the need for methods of conserving electrical energy.

2. After completing the activity, the student will be able to:

   a. Describe economic reasons for reducing electrical demand.

   b. List factors which may affect electrical consumption in the home.

   c. Recommend methods for lowering home electrical consumption.

Materials:

electric bills from each student

Procedures:

Ask students to determine the number of units used and the cost of electrical service to their homes from last month's electrical bill. Have them compare consumption and cost of electrical service with one another. After they have observed differences in cost and consumption, ask students to list variables which may account for these differences. When all the variables have been listed, have them discuss which variables account for the difference found between bills. The list should include the following:

   a. number of people living in the home

   b. the number of appliances which use electricity

   c. type of het and hot water heater

   d. life style or living habits

Submitted by: Dan Oden

CAPSULE IDEAS ON ENERGY USE

Conservation/fuel. Count people in 20 consecutive cars that pass. How many cars would be needed (assume 5/car) for this number you counted? How many times as many gallons of gasoline are used by 20 cars as compared to car of 5 people.

Submitted by: Edwin Thomas

Conservation/water/fuel. Adjust hot water faucet to leak at a rate of about one drop/second. Place empty measuring cup underneath faucet. Measure how long it takes to catch 8 ounces; calculate amount wasted in 24 hours. Determine how much energy is needed to heat hot water tank; calculate how much energy is wasted in 24 hours.

Submitted by: Edwin Thomas

Write an energetic poem about a current news article about energy. Try a five-line cinquain poem which is built on the following structure:

line 1 - one word (noun)
line 2 - two words describing the noun (objectives)
line 3 - three words (verbs)
line 4 - four words (showing the author's feeling or reaction to the noun)
line 5 - one word (usually a noun which is a synonym for the noun in line 1)

Submitted by: Shirley Wahlstrom

Devise a solar collector from an aluminum pie plate and use a thermometer to measure the heat "collected" (focused at a point).

Submitted by: Bro. Xavier Pankovits

Place the opened end of a large paper clip through a half of a raw peanut (shelled). Light the peanut and ask the students where the energy comes from.

Submitted by: John Norman